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# **CORRECTIVE MEASURES STUDY REPORT**

***Solutia Nitro Site  
Nitro, West Virginia***

**Permit No. WV039990965**

*Prepared for:*

**Solutia Inc.**

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The logo features a stylized 'P' composed of several horizontal blue bars of varying lengths, creating a sense of depth and movement.

**POTESTA**

# TABLE OF CONTENTS

1.0	EXECUTIVE SUMMARY .....	1
2.0	INTRODUCTION .....	2
2.1	Background .....	2
2.2	Purpose.....	2
2.3	Organization.....	3
3.0	SUMMARY OF SITE SETTING AND HISTORY.....	3
3.1	Geographic Setting.....	3
3.2	Manufacturing History.....	4
3.3	Site Geology.....	5
4.0	SUMMARY OF ENVIRONMENTAL INVESTIGATIONS AND STABILIZATIONS.	6
4.1	RCRA Facility Assessment and Investigation.....	6
4.2	CA-750 Environmental Indicators Facility Investigation.....	8
4.3	Site Stabilization Measures and SWMU Closures.....	9
4.4	Expanded Investigation of Site-wide Soils and Groundwater .....	10
4.5	Conclusions and Outcomes.....	10
4.5.1	Constituents of Concern.....	11
4.5.2	Conceptual Site Model and Corrective Measures Objectives.....	11
5.0	REMEDIAL TECHNOLOGY SELECTION.....	13
6.0	INTERIM REMEDIAL MEASURES IMPLEMENTATION .....	14
6.1	Engineering Controls .....	15
6.1.1	Site-wide Groundwater - Source Area Containment and Treatment .....	15
6.1.2	Site-wide Soils and SWMUs - Caps and Covers .....	15
6.1.3	Effect of Engineering Controls .....	15
6.2	Institutional Controls .....	16
6.3	Maintenance and Monitoring.....	16
6.4	Reporting.....	17
6.5	Conceptual Site Model – Post IRMs.....	17
7.0	CORRECTIVE MEASURES RECOMMENDATIONS .....	18
7.1	Proposed Approval of In-place IRMs as Final Engineering Remedial Measures	19
7.2	Proposed Approval of the IM-EMP as the Final Site Monitoring Plan.....	19
7.3	Proposed Installation of Containment Area P&T Extraction and Treatment System and Acceptance as Final Remedial Measure.....	19
7.4	Proposed Continued ICs and Approval as Final Administrative Remedial Measures .....	19
7.5	Proposed Continued Implementation of the Site Monitoring and Maintenance Plan .....	19
8.0	ENDNOTES .....	20

## **APPENDICES**

Historical Site Use and Ownership .....	APPENDIX A
CA-750 EI Questionnaire .....	APPENDIX B
Stabilization Measures Preceding IRMS .....	APPENDIX C
April 2010 Final Interim Measures Work Plan.....	APPENDIX D
Interim Measures Technical Specs .....	APPENDIX E
Figures.....	APPENDIX F
Final Caps and Covers Maintenance and Monitoring Plan .....	APPENDIX G

## ACRONYMS AND DEFINITIONS

Agencies	USEPA and WVDEP
COCs	Constituents of Concern (i.e., constituent concentrations in Site environmental media that are greater than an established health based screening levels for that respective media)
CMOs	Corrective Measures Objectives
CMS	Corrective Measures Study
CSM	Conceptual Site Model
DCE	Dichloroethylene
Dioxin	2,3,7,8 tetrachlorodibenzo-para-dioxin (TCDD)
ERFI	Expanded RCRA Facility Investigation conducted in 2Q05 – 3Q06
ERFI Report	Final Draft Expanded RCRA Facility Investigation Report, February 16, 2007, Potesta & Associates, Inc.
Flexsys	Flexsys America L.P., a 50/50 Joint Venture between Old Monsanto and Akzo-Nobel incorporated in 1995
HDPE	High-density polyethylene
HH&E	Human Health and the Environment
ICs	Institutional Controls
IRMs	Interim Remedial Measures
IM-EMP	Interim Measures Effectiveness Monitoring Plan
IMO	Interim Measure Objective
LF	Linear feet
New Monsanto	The Monsanto Company first incorporated as a subsidiary of Pharmacia in 2000 and then spun off as a separate, publicly held company in 2002
Old Monsanto	The original Monsanto Chemical Company incorporated in 1901
PA	“Process Area” within the Solutia Nitro Site
PCE	Tetrachloroethylene or perchloroethene
PDA	“Past Disposal Area” within the Solutia Nitro Site
pg/l	picograms per liter
RCRA Corrective Action Permit	Solutia Nitro Site RCRA Corrective Action Permit, I.D. WV039990965 (Part A), issued November 2, 1990 to Old Monsanto, transferred to Solutia in 1997, and renewed by Solutia in 2000 and 2010.
RCRA Operating Permit	Site Permit, I.D. WV039990965(Part B), issued in 1987 to Old Monsanto, transferred to Flexsys in 1995 and remaining effective until 2005 when it was terminated by Flexsys, the Site operator at that time, after cessation of all operations and dismantling of all above ground facilities.
POTESTA	Potesta & Associates, Inc.
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation

Source Area	The Former Rubber Chemicals Manufacturing Area within the PA with high concentrations of PCE, TCE, DCE and VC in groundwater
TCDD	2,3,7,8 tetrachlorodibenzo-para-dioxin (Dioxin)
TCE	Trichloroethylene
“Safe Load Level”	The maximum level of Dioxin transport from the Site to the Kanawha River from all Site sources that is considered safe for HH&E as established in the Total Maximum Daily Load report
Site	Solutia Nitro facility (a.k.a. the Flexsys America L.P. Nitro, West Virginia chemical production facility), located in the City of Nitro in Putnam County, West Virginia.
Solutia	Solutia Inc.
SWMU	Solid Waste Management Unit
TMDL	Dioxin Total Maximum Daily Load (i.e., for TCDD)
USEPA	United States Environmental Protection Agency Region 3
VC	Vinyl chloride
WTA	Solutia Nitro Site former Wastewater Treatment Area
WVDEP	West Virginia Department of Environmental Protection
WQS	West Virginia Water Quality Standard

## **Corrective Measures Study**

### ***Solutia Inc. Nitro Site Nitro, West Virginia***

#### **1.0 EXECUTIVE SUMMARY**

Potesta & Associates, Inc. (POTESTA), on behalf of Solutia Inc. (Solutia), prepared this Corrective Measures Study (CMS) report for the Solutia Nitro, West Virginia facility [a.k.a. the Flexsys America L.P. (Flexsys) Nitro, West Virginia, chemical production facility]. The facility is located approximately one-half mile north of the City of Nitro in Putnam County, West Virginia (Site). Manufacturing of chemical compounds began at the Site in 1918 and continued until mid-2004 when all manufacturing operations and associated activities ceased. All above grade facilities were demolished by December 2005.

The purpose of a CMS, as defined by United States Environmental Protection Agency (USEPA), is to identify and evaluate potential remedial alternatives to address releases from a Site to the environmental media – both on-Site and off-Site. In general, remedial decisions are made by comparing possible remedies against threshold criteria and balancing factors. However, this CMS takes a more focused, streamlined approach. It presents approved Interim Remedial Measures (IRMs) already implemented at the Site; describes how the Site Corrective Measures Objectives (CMOs) will be achieved; and proposes additional monitoring and maintenance activities required to manage releases of Site-related constituents of concern (COCs) to environmental media and ensure the ongoing protection of Human Health and the Environment (HH&E).

USEPA and the West Virginia Department of Environmental Protection (WVDEP) (together Agencies) approved comprehensive Site-wide IRMs in June 2010 and installation began in 2011. Installation of the IRMs was sufficiently completed by the end of 2014 to fully ensure protection of HH&E. The specific objectives of this CMS Report are as follows:

- Summarize Site RCRA environmental investigations and conclusions.
- Summarize Site CMOs.
- Summarize the selection and implementation of Site-wide IRMs.
- Present the updated Conceptual Site Model (CSM) and status of potentially unacceptable exposure pathways based on the current (post-IRM) conditions.
- Describe the remedy and monitoring proposed to meet Site CMOs and thus ensure the ongoing protection of HH&E.

The specific remedy and monitoring proposed for this Site are summarized as follows:

- Propose Site Caps and Covers installed as IRMs over virtually the entire Site, including the riverbank, as the final remedy for Site soils and Solid Waste Management Units (SWMUs).
- Propose the four groundwater containment areas installed as IRMs as a final remedy for Site-wide groundwater.
- Propose to complete installation of groundwater extraction systems for each of the four containment areas and install a Site-wide groundwater treatment facility for extracted groundwater.
- Propose the Interim Measures Effectiveness Monitoring Plan (IM-EMP) as the final Site remedy monitoring plan.
- Propose to develop and implement additional Institutional Controls (ICs) to provide another level of protectiveness for the continued protection of HH&E.
- Propose to prepare and implement a Final Caps and Cover Monitoring and Maintenance Plan to ensure continuing effectiveness of the final remedy.

## **2.0 INTRODUCTION**

POTESTA prepared this CMS report on behalf of Solutia. The Site is located approximately one-half mile north of the City of Nitro in Putnam County, West Virginia.

### **2.1 Background**

On May 26 1987, the USEPA issued to Monsanto Chemical Company<sup>i</sup> (Old Monsanto) the operating portion of the Resource Conservation Recovery Act (RCRA) Permit (i.e., Part B of Permit No. WV039990965), hereafter referred to as the “RCRA Operating Permit”. The RCRA Operating Permit was transferred to Old Monsanto successor companies, remaining effective until 2005 when it was terminated by Flexsys, the Site operator at that time, after cessation of all operations and dismantling of all above ground facilities.

On November 2, 1990, USEPA issued to Old Monsanto the Corrective Action portion of the RCRA Permit (i.e., Part A of Permit No. WV039990965) pursuant to the 1984 RCRA Hazardous and Solid Waste Amendments. Hereafter in this CMS report, the RCRA Part A Corrective Action permit will be referred to as the “RCRA Corrective Action Permit.” The RCRA Corrective Action Permit was extended in January 2001 and is in effect until such time that a new permit is issued.

### **2.2 Purpose**

The purpose of a CMS as defined by USEPA is to identify and evaluate potential remedial alternatives to address certain releases of COCs on-Site or off-Site to any environmental media. In general remedial decisions are then made by comparing possible remedies against “threshold criteria” and “balancing factors.” The Site’s RCRA Corrective Action Permit (i.e., Part II, Condition D, “Corrective Measures Study”) stated the purpose of the CMS as follows: “...to develop and evaluate remedial alternative(s) and to recommend the remedy(s) to be taken”. The

Site RCRA Corrective Action Permit additionally gave the permittee the following option in developing the CMS: “The permittee may elect either to screen a number of remedies or delete the screening step and proceed with evaluation of the expected remedy(s), including any specified by EPA”. This latter approach was taken in this CMS.

IRMs to address Site environmental media and all Site CMOs were proposed by Solutia and approved by the Agencies in 2010. Installation of the IRMs began in 2011 and was virtually completed by the end of 2014. The installed IRMs will be described and evaluated in this streamlined CMS as proposed final remedial measures.

The specific objectives of this CMS are to:

- Summarize Site RCRA environmental investigations and conclusions.
- Summarize Site CMOs.
- Summarize the selection and implementation of Site-wide IRMs.
- Present the updated CSM and status of potentially unacceptable exposure pathways based on the current (post-IRM) conditions.
- Describe the remedy and monitoring proposed to meet Site CMOs and thus ensure the ongoing protection of HH&E.

## **2.3 Organization**

This CMS is organized into the following sections:

- Section 3.0 summarizes the Site setting and history – including the geographic setting; manufacturing history; and geology.
- Section 4.0 presents a summary of Site assessments, environmental investigations, and conclusions. The primary Site COCs are listed and the CSM resulting from these Site investigations (i.e. prior to identification and implementation of IRMs) is presented.
- Section 5.0 presents a summary of the selection process for remedial technologies selected as IRMs.
- Section 6.0 addresses installed IRMs and presents an updated CSM.
- Section 7.0 summarizes the proposed corrective measures and recommendations.
- Section 8.0 presents the references cited in this report.

## **3.0 SUMMARY OF SITE SETTING AND HISTORY**

### **3.1 Geographic Setting**

The Site is located along the eastern (right-descending) bank of the Great Kanawha River (Kanawha River), approximately one-half mile north of the City of Nitro in Putnam County, West Virginia.

The Site encompasses approximately 118 acres and is divided into two separate areas by Interstate 64: 1) a southern area encompassing approximately 72 acres, which was the former Process Area (PA), which also incorporates a 9-acre past disposal area (PDA) and; 2) a northern area, encompassing approximately 46 acres, which was the former Wastewater Treatment Area (WTA) and included the wastewater treatment plant and wastewater impoundments. The Site is located in an area of industrial, commercial, and residential land use. Light industrial and commercial facilities are immediately adjacent to the Site on the north, east, and south. Residential areas are located within a 1-mile radius of the Site in all directions (a Site Location Map is included in **Appendix F**).

The Site was the previous location of a chemical manufacturing plant which began production of various chemical compounds in 1918 and continued until mid-2004. In October 2003, Flexsys made a business decision to cease all chemical production at the Site. Activities began during the second quarter of 2004 to dismantle, decontaminate, and remove all surface structures associated with manufacturing, administration, product storage and shipping, and the wastewater treatment facility. Demolition was completed in December 2005. **Appendix A** contains details on historical Site use and ownership history.

### **3.2 Manufacturing History**

Chemical production began at the Site in 1918 when the United States Government started producing smokeless powder (nitrocellulose) for use in World War I. Nitrocellulose production ended in 1921 when the Site was purchased by the Rubber Services Company and used for the manufacturing of chloride, phosphate and phenol compounds. Old Monsanto purchased the facility in 1929 from Rubber Services Company and added the manufacture of flotation agents, pickling inhibitors, anti-oxidants, anti-skinning, wetting agents, and oils to the existing production operations in the 1930s.

Old Monsanto continued to expand operations at the Site and accelerated its growth in the 1940s, including the production of the herbicide 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) and sodium trichlorophenoxyacetic acid. A byproduct of the production of 2,4,5-T was the creation of 2,3,7,8 tetrachlorodibenzo-para-dioxin (TCDD or Dioxin). Dioxin has been detected in surface soils at the Nitro Site. A pilot scale production of 2,4,5-T was initiated at the Site during the summer of 1948. Plant scale production began in October 1948 in Building 34. As the demand for the herbicide increased during the Vietnam War, a new integrated facility in Building 92 was constructed and came online in August 1963. Production of the herbicide continued until demand for the product eased and production ceased at the Site in 1969. Several of the units associated with the production of the herbicide were decontaminated, demolished, and buried on Site during the early 1970s.

The manufacturing of rubber chemicals initially comprised about 65 percent of the Site's operations. The product line was diversified with new additions over the years, including the aforementioned herbicide production and an animal feed nutritional additive, and additional rubber chemicals including vulcanization accelerators, vulcanization inhibitors, and anti-oxidants for miscellaneous rubber products. A variety of raw materials were used in the multiple

chemical production processes carried out at the Site over the years, including inorganic compounds, organic solvents, and other organic compounds.

In 1995, all production operations, maintenance and facility management of the Nitro plant were transferred from Old Monsanto to Flexsys, a joint venture between Old Monsanto and Akzo-Nobel. This transfer agreement gave Flexsys the entire Site and substantially all of the assets except the improved real estate and certain limited manufacturing assets. The RCRA Corrective Action Permit was modified (Class I modification) to reflect the change in permittee status from old Monsanto only to both Old Monsanto and Flexsys. Flexsys acquired responsibility for operational issues related to RCRA while Old Monsanto retained responsibility for RCRA Corrective Action.

In 1997, Old Monsanto spun off its chemical businesses to a newly created, publically held company, Solutia. The equity acquired by Solutia included Old Monsanto's interest in Flexsys, including the Nitro facility, as well as Old Monsanto's solely owned assets and liabilities at the Nitro Site. Assets included the real Site property while liabilities included responsibility for RCRA Corrective Action.

In 2000, Old Monsanto entered into a merger and changed its name to Pharmacia Corporation (Pharmacia). Also in 2000, a standalone subsidiary of Pharmacia was incorporated (New Monsanto) based on the previous agricultural division of Pharmacia. In 2002, New Monsanto was spun from Pharmacia as a separate company. Pharmacia became a subsidiary of Pfizer in 2003. In July 2012, Solutia became a subsidiary of Eastman Chemical.

In October 2003 Flexsys made a business decision to cease all chemical production at the Nitro Site. Activities began during the second quarter of 2004 to dismantle, decontaminate, and remove all surface structures including the wastewater treatment plant facility. Demolition was completed in December 2005. Solutia remained the owner of all real Site property and retained responsibility for RCRA Corrective Action.

### **3.3 Site Geology**

The Site lies within the limits of an alluvial plain adjacent to the Kanawha River. These alluvial deposits compose the uppermost aquifer existing at the Site. This aquifer is unconfined, and the depth to the groundwater surface generally varies from 15 to 25 feet below the ground surface across the Site. The nature and type of sediment within the alluvial deposits is highly variable across the Site. However, the general stratigraphic sequence of the sediments is a fining-upward grain size trend that is characteristic of most fluvial depositional environments. The underlying bedrock surface is composed of gray silty shale and claystone. This weathered surface is relatively flat across the property with a total relief of approximately 12 feet. The depth to bedrock varies from 50 to 60 feet at the Site due in part to subtle changes in elevation of the ground surface.

Even though considerable variability occurs in the alluvial sediments across the Site and surrounding area, the groundwater within these deposits is considered to be interconnected and can be characterized as a single unconfined aquifer.

Regional groundwater flow in the alluvial deposits at the Site is toward the Kanawha River across the entire Site. A major groundwater divide exists to the northeast of the WTA. This divide generally coincides with the alignment of railroad tracks existing between the Kanawha River and the Armour Creek backwater area.

Aquifer testing conducted during the development of the RCRA Corrective Action Permit indicated a considerable range in hydraulic conductivity both laterally and vertically in the alluvial deposits. Hydraulic conductivities range from 0.1 to 1 foot per day in the shallow aquifer to 5 to 10 feet per day in the deeper zone. These results are consistent with the general fining-upward trend in the gradation of the alluvial sediments.

#### **4.0 SUMMARY OF ENVIRONMENTAL INVESTIGATIONS AND STABILIZATIONS**

The numerous environmental investigations pursuant to RCRA Corrective Action conducted between 1986 and 2007 are summarized in this section. Site remedial actions and stabilization measures that took place during this same 20-year period, including the closure of some SWMUs, are discussed as well. The following are discussed below in Sections 4.1 to 4.5:

- 1986 RCRA Facility Assessment and 1995 RCRA Facility Investigation (Section 4.1)
- 2003 CA-750 (Groundwater) Environmental Indicators Facility Investigation (Section 4.2)
- 2004-2006 Expanded Investigation of Site-wide Soils and Groundwater (Section 4.3)
- 1986-2007 Site stabilizations and SWMU closures (Section 4.4)
- Major conclusions and Site primary COCs developed from information gathered from these environmental investigations (Section 4.5)

The original Site CSM is discussed in Section 4.6 (i.e. after closure of some SWMUs and early stabilizations - but prior to selection and installation of IRMs). Site CMOs are also listed in Section 4.6.

#### **4.1 RCRA Facility Assessment and Investigation**

A RCRA Facility Assessment (RFA) was conducted at the Site by USEPA in 1986. The results were reported in a December 4, 1986 report entitled, "Phase II Revised RCRA Facility Assessment of the Monsanto Company, Nitro, West Virginia" (RFA Report), prepared for the USEPA by A. T. Kearney, Inc. Pursuant to the 1986 RFA, the Nitro facility was issued a RCRA Corrective Action Permit November 2, 1990.

The RCRA Corrective Action Permit specified 14 Solid Waste Management Units (SWMUs) to be investigated and the environmental media (groundwater, soil, sediment, and surface water) to be investigated for each. Both the RFA Report and the RCRA Corrective Action Permit identified groundwater as the primary environmental media to be investigated. Groundwater investigations were specified by the RCRA Corrective Action Permit for all but one of the 14 SWMUs. The 14 defined SWMUs were:

### **Process Area (PA)**

#### **1 - Past Disposal Area (PDA)**

##### **Three areas within the PDA**

- 2 - Teepee Incinerator
- 3 - Niran Residue Pits
- 4 - Aboveground Equalization / Stormwater Surge Tanks
- 5 - Facility Sewer System
- 6 - Building 46 Incinerator

### **Waste Water Treatment Area (WTA)**

#### **Waste Disposal Sites**

- 7 - City of Nitro Dump
- 8 - Waste Pond
- 9 - Decontaminated 2,4,5-T Building

#### **Closed Impoundments**

- 10 - Surge Basin
- 11 - Equalization Basin
- 12 - Limestone Bed
- 13 - Emergency Basin
- 14 - Wastewater Treatment Plant, Consisting of the Activated Sludge Basin, the Secondary Clarifier, and the Tertiary Clarifier

Pursuant to the RFA Report and the 1990 RCRA Corrective Action Permit, Old Monsanto conducted the initial investigation of the 14 RCRA SWMUs requiring further evaluation in August and September of 1994. The results were reported in the "RCRA Facility Investigation and Stabilization/Corrective Measure Plan", May 5, 1995, and the Addendum, dated August 7, 1995<sup>ii</sup>, both by Roux Associates, Inc. The objectives of this initial RCRA Facility Investigation were defined as:

- Characterize the nature, extent, concentration, and migration of hazardous constituents released from SWMUs into groundwater and surface water.
- Identify actual or potential receptors.
- Provide a detailed geological and hydrogeologic characterization of the area surrounding the SWMUs.

Completion of the 1995 RFI was followed by several years of continuing Site operations, during which time some focused environmental investigative studies were conducted to provide some additional environmental data. These interim environmental studies preceding the 2003 CA-750 Environmental Indicators Facility Investigation in 2003 (see next section) included:

- Site soils investigations in 1999 focused on delineation of Dioxin concentrations throughout the Site.
- A comprehensive investigation of soils and wastes in the PDA and three internal PDA SWMUs was conducted and documented in July - August 2003.<sup>iii</sup>
- Kanawha River sediment and surface water sampling in 2001, 2002, and 2003.

#### **4.2 CA-750 Environmental Indicators Facility Investigation**

Solutia completed an initial groundwater investigation in 2003 pursuant to the CA-750 "Migration of Contaminated Groundwater Under Control Environmental Indicators Report" (CA-750 EI). Results from this investigation were published in the "Documentation of Environmental Indicator Determination Report," dated December 2003 (CA-750 EI Report). Additional analytical results relevant to the CA-750 EI pursuant to surface water and sediments were added in a supplemental report to the 2003 CA-750 EI Report entitled, "Revised Data Report, CA-750 Groundwater Environmental Indicators," by POTEITA, dated May 2004 (CA-750 EI Data Report). This revised report summarized the field and analytical work conducted at the Site during the CA-750 Groundwater Characterization Investigation of 2003 and added data from the Kanawha River Sediment and Surface Water Sampling events of 2001, 2002, and 2003. All data collected from these four events were presented in the CA-750 EI Data Report appendices in both tabular and electronic format.

The 2003 comprehensive CA-750 EI investigation of Site groundwater included the advancement of direct push points at 34 locations, 21 within the PA and 13 within the WTA. The objective of the field investigation was to collect representative groundwater samples from three distinct depths at each temporary sampling location and define the horizontal and vertical extent of groundwater containing Site-related constituents. Three samples were collected at each of the 34 locations throughout the facility limits providing grab samples from three zones within the unconsolidated aquifer beneath the Site, resulting in 102 total samples. These sampling horizons generally adhered to the following depths:

- Zone A: Phreatic surface sampling points, generally located at a depth of 25 to 30 feet below the ground surface.
- Zone B: Mid Aquifer sampling points, located at a midpoint in the unconsolidated aquifer between the phreatic surface and the bedrock horizon.
- Zone C: Basal Aquifer sampling points, located at the bedrock interface, generally located at depths ranging from 55 to 60 feet below the ground surface.

The CA-750 EI Data Report presented analytical results and summarized the field efforts and methods used to collect the groundwater, sediment, and surface water samples described in the following work plans:

- *Site Assessment Work Plan – Final; CA-750 Groundwater Characterization Investigation; Process and Wastewater Treatment Plant Areas, Flexsys America, L.P. Facility, Nitro, WV, May 2003*
- *Supplemental Surface Water and Sediment Sampling Work Plan – Final; Kanawha River Reach, Flexsys America, L.P. Facility, Nitro, WV, September 13, 2002 as supplemented by letter to Jennifer Shoemaker, dated November 12, 2002*
- *Kanawha River Sediment and Surface Water Sampling Work Plan – Final; Kanawha River Reach, Flexsys America, L.P. Facility, Nitro, WV, September 2001*

All CA-750 EI conclusions were based on these analytical results and summarized in the CA-750 EI Questionnaire<sup>iv</sup> (see **Appendix B**), as submitted to the Agencies in December 2003. Major conclusions as reported on the CA-750 EI Questionnaire included:

- Groundwater contains COCs above protective levels (i.e., applicable promulgated standards) from releases subject to RCRA Corrective Action.
- It is unknown if the migration of COC affected groundwater has stabilized on the northern and southern boundaries.

The second conclusion necessitated an additional investigation. This investigation is discussed in Section 4.4 following the following discussion on Site stabilizations and SWMU closures.

#### **4.3 Site Stabilization Measures and SWMU Closures**

The stabilization measures and SWMU closures listed below were completed before the next major environmental investigation was conducted in 2004-2006. This investigation was an expanded RFI and is discussed in Section 4.4 below. More detail on each closure and stabilization measure listed below is provided in **Appendix C**.

- SWMU closures in the WTA
  - SWMU 8 - 0.5-acre waste pond
  - SWMU 10 – Surge Basin
  - SWMU 12 - Limestone bed
  - SWMU 11 - 5 million gallon Equalization Basin
  - SWMU 13 - 10 million gallon Emergency Basin
  - A3 Basin
  - SWMU 14 – Waste Treatment Plant – consisting of the 2-million gallon Activated Sludge Basin; Secondary and Tertiary Clarifiers; and Digester
- SWMU 4 - four above ground Equalization/Stormwater Surge Tanks in the PA
- SWMU 5 – Site-wide combination process/stormwater sewer closed, stabilized and isolated
- SWMUs 1, 2, 3 and 6 - PDA stabilization

- Riverbank slough stabilization
- Interim Measures including:
  - Site-wide Stormwater migration control
  - Site-wide Groundwater migration control
  - LNAPL migration control in the PDA

#### **4.4 Expanded Investigation of Site-wide Soils and Groundwater**

In October 2003 Flexsys announced a business decision to cease operations at the Site in a timely manner and to dismantle all facilities. While the Site continued to operate in 2004, the Agencies and Solutia conducted an extensive review of the Site operational history and the historical environmental database, including the recently completed CA-750 EI Data Report, pursuant to Solutia's continued post-shutdown obligations associated with RCRA Corrective Action.

The overall conclusion from this review was that an additional Site environmental characterization would be required for groundwater, Site soils, and some SWMUs to address some remaining gaps in the database. In addition, the Agencies and Solutia hypothesized that groundwater flow within the Site may be a transport mechanism for Dioxin to off Site receptors (*i.e.*, the Kanawha River), and that additional information is needed to assess the validity of this hypothesis.

In a follow-up July 2, 2004 meeting between Solutia and the Agencies, the Agencies accepted a Solutia recommendation to generate needed supplemental characterization information on Site groundwater and other environmental media pursuant to an Expanded RFI (ERFI) Work Plan. It was further agreed that the ERFI would consist of two elements: (1) Groundwater (ERFI-GW); and (2) Soils and SWMUs (ERFI-Soils and SWMUs). The objective of the ERFI was to provide sufficient additional environmental media characterization to develop a detailed CSM and to identify Corrective Action alternatives.

Detailed work plans were developed and approved for the ERFI-GW<sup>v</sup> and the ERFI-Soils and SWMUs<sup>vi</sup> scopes of work in November 2004 and May 2006, respectively. Results from the ERFI investigations were documented in a February 2007 ERFI Report<sup>vii</sup>.

#### **4.5 Conclusions and Outcomes**

The comprehensive environmental studies discussed above resulted in a thorough Site characterization and understanding of the nature and extent of Site wastes; provided additional delineation of identified Site COCs; defined COC transport mechanisms; and defined affected environmental media. Major conclusions from these studies and the CSM are detailed in the ERFI Reports and summarized as follows:

- Dioxin is migrating from the Former 2,4,5-T Manufacturing Area, the PDA, and the Closed Wastewater Impoundments via the groundwater and/or surface water pathways and discharging to the Kanawha River.

- Tetrachloroethene (also known as perchloroethene or PCE) or its breakdown products (trichloroethylene or TCE; dichloroethene or DCE; and vinyl chloride or VC) are migrating from the Former Rubber Chemicals Manufacturing Area (Source Area) via the groundwater pathway and discharging to the Kanawha River.
- Removal and disposal and/or on Site treatment of source areas and waste disposal areas at the Site are impracticable for the following reasons:
  - The presence of Dioxin in Site environmental media and the unavailability of off Site treatment / disposal alternatives within the United States.
  - The areal and vertical extent of affected media.
  - The overall volume of affected soils, waste, and groundwater on this 118-acre Site.
  - Heterogeneity of wastes in source areas.

#### 4.5.1 Constituents of Concern

The primary Site related COCs identified as a result of the Site environmental investigations are:

CLASS	CONSTITUENT
Volatile Organic Compounds	1,1-dichloroethylene Benzene Carbon Tetrachloride Tetrachloroethene Trichloroethene Vinyl Chloride
Semivolatile Organic Compounds	Total PAHs Phthalate Esters
Herbicide	2,4-Dichlorophenoxyacetic acid (2,4-D)
Dioxins/Furans	2,3,7,8-TCDD

#### 4.5.2 Conceptual Site Model and Corrective Measures Objectives

A CSM developed for the Site following completion of the 2005-2006 ERFI is summarized below and discussed in detail in Section 4.0 of the ERFI Report. The CSM identified completed exposure pathways with unacceptable risks. The CSM divided the Site into three areas:

- Protect the River Land
- SWMUs, Surface Impoundments, Waste Disposal Areas, and the Former 2,4,5-T Manufacturing Area
- Potentially Clean Land

“Protect the River Land” is land where the CMO is to protect the river from stormwater transport of Dioxin and from groundwater transport of COCs. With respect to stormwater, that objective translates into controlling Dioxin concentration in stormwater discharging to the river such that compliance is maintained with the Solutia NPDES Permit requirements for the three Site stormwater outfalls. This objective is in support of the West Virginia Water Quality Standard

(WQS) for Dioxin concentration in the river of  $\leq 0.014$  picograms per liter (pg/l). With respect to groundwater, the objective is the same across the entire Site: to control the migration of Groundwater COCs to a level that is protective of surface water quality, human health, and the environment.

“SWMUs, Surface Impoundments, Waste Disposal Areas, and the Former 2,4,5-T Manufacturing Area” consists of the PDA SWMU and the Former 2,4,5-T Manufacturing Area in the PA. The WTA contains six closed SWMUs (Waste Pond, Limestone Bed, Equalization Basin, Emergency Basin, Surge Basin, and Aboveground Stormwater/Equalization Tanks), two closed surface impoundments (Waste Water Treatment Plant Digester and A3 Basin), and two waste disposal areas (Old Nitro Dump and the Former 2,4,5-T Production Building Demolition Debris Disposal Area). The primary objective for these areas, in addition to the same objectives listed for the “Protect the River Land”, is to prevent potential exposures of current and future Site users to affected soils and wastes.

“Potentially Clean Land” is Site areas that have never been associated with manufacturing or waste disposal activity, but may have some affected soils. The objective for these areas is to prevent potential exposures to current and future Site users to affected soils.

#### Corrective Measures Objectives Summary

The CMOs discussed above are detailed in Section 7.0 of the ERFI Report and summarized as follows:

#### Short-Term CMOs

- 1) Implement Site Health and Safety Plan and Site security procedures to prevent exposure of any future industrial and construction workers and trespassers to source area soils and wastes.
- 2) Control Site groundwater sources and monitor Dioxin, PCE, TCE, DCE, and VC concentrations in groundwater to confirm improvement over time following Interim Measures implementation.
- 3) Control Site groundwater use until long-term CMOs are achieved.
- 4) Monitor groundwater downgradient of the Former Rubber Chemicals Manufacturing Area and the Wastewater Treatment Area.
- 5) Maintain storm water compliance with the NPDES Permit.

#### Long-Term CMOs

- 1) Prevent exposures of future Site users and trespassers to soils and wastes
- 2) Control migration of Dioxin to the Kanawha River via the groundwater pathway such that the sum from all Site sources is below the "safe load level"<sup>viii</sup> for the Site.
- 3) Control migration of PCE and its breakdown products to the Kanawha River via the groundwater pathway to a level that is protective of surface water quality.

- 4) Determine if the Interim Measures are capable of achieving State and Federal groundwater cleanup criteria<sup>ix</sup> and if not, what additional actions are required for final RCRA Corrective Measures.

## 5.0 REMEDIAL TECHNOLOGY SELECTION

As the USEPA has worked through hundreds of individual cleanups, the RCRA program has found that similar remedies have been used successfully to address many similar sites. Using data from multiple clean-up sites, USEPA has defined some remedies as preferred technologies for common categories of sites, based on historical patterns of remedy selection and USEPA's scientific and engineering evaluation of how well technologies perform. Section 300.430(a)(iii)(B) of the USEPA National Contingency Plan establishes that engineering controls, such as containment, coupled with monitoring, institutional controls, etc. may be appropriate "presumptive" remedial actions for some sites. Presumptive Remedies have already been confirmed by USEPA to adequately address the following seven corrective measures threshold criteria and balancing factors:

- Long-Term Effectiveness
- Reduction of Toxicity, Mobility, and Volume Reduction
- Short-Term Effectiveness
- Implementability
- State Acceptance
- Community Acceptance
- Costs

The thorough Site Characterization; early stabilization actions and some SWMU closures; and a detailed CSM resulting from the multiple environmental investigations discussed in Section 4.0, established the Site as a potential candidate for a results-based Corrective Action approach employing the use of Presumptive Remedies. On February 20, 2008, Solutia met with representatives of the Agencies at USEPA Region III headquarters in Philadelphia to review the comprehensive environmental studies' results and Site CSM. Potential remedial technologies were presented and discussed, including an array of Presumptive Remedies. In an April 25, 2008 letter from Mr. William Wentworth, USEPA Remedial Project Manager, to Mr. Michael House, Solutia Remediation Services Manager, the Agencies expressed agreement with the conceptual corrective actions presented at the February 20<sup>th</sup> meeting and with Solutia's commitment to meet applicable State and Federal groundwater requirements.

Following additional Agencies/Solutia reviews of the Site investigative results and discussions concerning potential specific remedies and procedural pathways, a comprehensive plan for remedial action was proposed by Solutia in a November 9, 2009 *Draft Interim Measures Work Plan*. Pursuant to subsequent discussions with the Agencies, this plan was followed by an April 2010 *Final Interim Measures Work Plan*<sup>x</sup>, which was approved by the Agencies in a June 29, 2010 letter from Mr. William Wentworth, Region III USEPA Project Manager, to Mr. Michael House, Remediation Services Manager, Solutia Inc. (See **Appendix D.**)

Containment-in-place was selected as the major engineering control to address Site groundwater source areas to manage the potential for off-Site transport of COCs and to mitigate potential exposure pathways. Following is a listing of the major elements of the containment-in-place control:

1. Groundwater source areas to be contained by barrier walls and impermeable caps.
  - a Contained groundwater source areas to be pumped at sufficient rates to maintain inward hydraulic gradients across the barrier walls.
  - b The extracted water to be treated prior to discharge to surface water via NPDES permitted outfall.
  - c An area-wide groundwater flow model was developed to support the specific Site groundwater source area containment design and monitoring plan.
2. Site soils to receive impermeable and permeable vegetated soil covers and the Site riverbank to be stabilized and covered with riprap to mitigate potential COC exposure pathways and prevent potential transport of COCs off-Site at levels exceeding applicable and relevant standards.
3. Institutional Controls to be developed and implemented, including:
  - a Land use restricted to commercial/industrial via restrictive covenant(s)<sup>xi</sup>.
  - b Prohibition of groundwater extraction via restrictive covenant for any reason other than monitoring and/or treating.
4. Periodic monitoring of groundwater and surface water.
5. Periodic reporting on progress toward achievement of long-term Site CMOs.

To streamline technology approval and installation, Solutia and the Agencies further agreed that the selected remedial technologies would be implemented as IRMs. A technical specification for each IRM is presented in **Appendix E**, "Interim Measures Technical Specifications." **Appendix F** contains Figures 4.1 and 4.2, which visually display on Site maps the types and locations for all IRMs.

## **6.0 INTERIM REMEDIAL MEASURES IMPLEMENTATION**

Following Agencies' approval of IRMs in June 2010, each IRM final design was sequentially completed and approved by the Agencies prior to installation.

## **6.1 Engineering Controls**

### **6.1.1 Site-wide Groundwater - Source Area Containment and Treatment**

Installation of the major groundwater source area engineering control components of the approved IRMs began in 2011 and was completed in 2012. Isolation and containment of groundwater source areas involved installation of over 8000 linear feet (LF) of 3-foot thick soil-bentonite slurry walls surrounding four areas totaling approximately 22 acres of the 118-acre Site. The areas contained included parts of the PA, virtually all of the PDA, and two areas in the WTA. The bottom of the soil-bentonite slurry trenches were keyed into the bedrock, which is present at an average depth of approximately 60 feet below grade throughout the Site. The installed slurry walls met the required permeability specification of  $<1 \times 10^{-7}$  cm/sec.

Groundwater from inside of the four soil-bentonite slurry wall containment areas will be extracted to maintain inward gradients across the barrier walls via extraction wells: two in the PA; four in the PDA; and three in the WTA. The groundwater extracted to maintain an inward gradient will be collected and pumped to an iron pretreatment unit, and then pumped to a granular activated carbon (GAC) treatment facility prior to discharge to surface water via NPDES Outlet 001 in the PA.

### **6.1.2 Site-wide Soils and SWMUs - Caps and Covers**

Construction of the engineering controls continued in 2012 through 2015 and is nearing completion with installation of three types of caps and covers over virtually the entire 118-acre Site. The three types of Site caps and covers were:

- Low Permeability Caps over all containment areas - Consisting of a non-woven geotextile, 40-mil high-density polyethylene (HDPE) geomembrane, composite drainage layer including perforated pipe and aggregate underdrains, and an 18-inch soil cover layer.
- Low-Permeability Covers - Consisting of a 40-mil HDPE geomembrane, non-woven geotextile and an 18-inch soil layer.
- Permanent Permeable Cover – Consisting of a nonwoven geotextile and an 18-inch soil layer.
- Approximately 2400 linear feet (LF) of the Site's river bank along the Kanawha River was covered and armored with rip-rap.

**Appendix E** contains the entire list of Technical Specifications for each type of cap and cover.

### **6.1.3 Effect of Engineering Controls**

Site caps and covers have addressed virtually all Site soils. The projected effect is a reduction in the Dioxin migration to the River via surface water by 100 percent from the already very low pre-IRM levels.

According to the groundwater modeling developed for the Site, the barrier walls will have a large effect on the amount of water flowing into the river from the source areas. Even without pumping, the flow from within the barrier walls into the river is reduced by 99.65 percent. Therefore, with completion of the barrier walls, and caps and covers addressing Site groundwater, Dioxin loading to the river from Site groundwater is expected to be almost completely reduced compared to the already very low levels that existed prior to the IRMs. The average Dioxin concentration in Site groundwater discharging to the river is expected to be well below the Total Maximum Daily Load (TMDL) target of 0.014 pg/l for the Kanawha River.

The total effect of the completed engineering controls is a nearly complete reduction in Dioxin migration to the River. Significant reductions in the migration of other Site COCs to the river via groundwater will be realized as well.

## **6.2 Institutional Controls**

ICs reduce the potential for human exposure by preventing/controlling Site access and any future Site uses that could result in unacceptable levels of exposure to underlying affected soils, wastes, and groundwater. ICs generally fall into two categories: Site access controls and administrative controls. Some Site access controls have been in place for some time and will continue to be maintained and monitored. These include security fencing and warning signs.

Administrative controls are actions that limit land use or Site access through public agencies, records, or other non-engineering means. Administrative controls include such measures as deed restrictions, purchase or lease agreements, zoning controls, community notices, protocols for any intrusive activities, or other land use controls or management systems. Site administrative controls are still being developed/implemented and will include: land use restrictions to limit Site activities to commercial/industrial via restrictive covenants<sup>xii</sup> and prohibition of groundwater extraction via restrictive covenants for any reason other than monitoring and/or treatment.

## **6.3 Maintenance and Monitoring**

Reductions in the migration of Site COCs to the Kanawha River over time will be confirmed and tracked via the Interim Measures Effectiveness Monitoring Plan<sup>xiii</sup> (IM-EMP). The IM-EMP is a long-term monitoring and evaluation plan initiated in the first quarter 2015. The purpose of the IM-EMP is to assess the effectiveness of the IRMs in achieving Site CMOs over time. The design of the IM-EMP was based on area-wide groundwater modeling performed by GSI Environmental Inc., Houston, Texas and documented in two reports<sup>xiv</sup>. Cross-barrier hydraulic gradient measurements were initiated in the first quarter 2015 at each of the cross-gradient well pairs in the four containment areas. Transducers were installed to periodically record the cross-barrier gradients for evaluation and reporting.

The engineered Caps and Covers system requires inspection and maintenance to ensure its continuous effectiveness. Periodic inspection and maintenance will continue through the life of the final remedy to maintain its effectiveness to protect health and safety of any Site workers and

to prevent the possibility of trespasser exposure to affected Site soils, waste, and groundwater. A Caps and Covers Maintenance and Monitoring Plan has been developed.

#### **6.4 Reporting**

An annual IM-EMP report will be submitted to the Agencies by February 20<sup>th</sup> of the current year for the prior year report period. The annual IM-EMP report will summarize the sampling and inspection results from the previous year and assess progress toward achievement of Site CMOs. The annual IM-EMP report will include the following:

- Summary of inspection findings and maintenance performed or planned as a result of the periodic inspection of the caps and covers.
- Status summary of all Site ICs relative to Site compliance with each IC.
- Analytical data collected during the year, including:
  - A results summary of COC sampling results from the IM-EMP groundwater monitoring wells.
  - A results summary of cross-barrier gradient monitoring piezometers and interpretation of those results.
  - PA, PDA, and WTA averages of analytical results for each COC in groundwater will be calculated and reported.
  - Site stormwater sampling results and comparison to NPDES Permit limits.
  - Groundwater treatment volumes and discharge analyses.
  - Discussion and/or visual tracking tools relative to Site progress toward achievement of Site CMOs.

The first annual IM-EMP report will be issued by February 20, 2016 for the year 2015.

#### **6.5 Conceptual Site Model – Post IRMs**

Site CMOs for soils, wastes, and groundwater presented below must control: 1) the potential for human exposure to wastes and impacted soil and groundwater in the source areas, and; 2) migration of Dioxin and PCE (and its breakdown products) from the groundwater source areas to the Kanawha River via the groundwater and/or surface water pathways. CMOs for Site soils and waste are:

- Prevent exposure of current and future Site users and/or trespassers to wastes, soils, and groundwater.
- Control migration of Dioxin to the Kanawha River such that the groundwater and surface water discharges do not exceed the “safe load level” for the Site.
- Control migration of PCE and its breakdown products to the Kanawha River such that the groundwater discharge does not cause an exceedance of WQSs in the river<sup>xv</sup>.

USEPA’s groundwater protection and clean-up strategy for RCRA Corrective Action is to address the greatest risks first and to make meaningful progress toward the ultimate goal of

returning groundwater to its maximum beneficial use. USEPA also expects final remedies to control or eliminate surface and subsurface sources of groundwater contamination.

Short-term CMOs for the Nitro Site groundwater include:

- Control Site source areas and monitor concentrations of Dioxin and PCE and its breakdown products to confirm improvement over time.
- Control Site groundwater use.

The West Virginia Groundwater Protection Act [WV Code § 22-12-4(b)] states that achievement of groundwater cleanup criteria will require reasonable efforts to mitigate further releases of contaminants from SWMUs, impoundments and affected soils, using the Site boundary as the point of compliance, and reduction of contaminant levels, as practicable, over time. The long-term CMO for Site-wide groundwater is:

- Achievement of State and Federal cleanup criteria.

Installed IRMs address all Site CMOs. The Site-wide caps and covers and ICs address CMOs by preventing the potential for human exposures to wastes and impacted soils and groundwater and by cutting off the surface water pathways to the Kanawha River for Site COCs. Groundwater source containment in combination with groundwater pumping to maintain inward hydraulic gradients address the major groundwater source areas for COC transport to the Kanawha River via groundwater. Control of the major groundwater source areas will reduce COC levels over time and over the long-term, achieve State and Federal cleanup criteria.

## **7.0 CORRECTIVE MEASURES RECOMMENDATIONS**

The engineering and administrative controls in place will address all Site CMOs. The IM-EMP will provide the Agencies with a demonstration of the progress in achieving each Site CMO. Major long-term Site CMOs for each environmental media are:

### **Overall CMO:**

- Prevent exposures of current and future Site users and trespassers to soils and wastes

### **Soils and Waste CMO:**

- Control Site sources and monitor Dioxin, PCE, TCE, DCE, and VC concentrations in groundwater to confirm improvement over time
- Maintain compliance with the NPDES Permit

### **Site-Wide Stormwater:**

- Maintain compliance with the NPDES Permit

### **Site-Wide Groundwater CMO:**

- Control migration of Dioxin to the Kanawha River such that the sum from all Site sources is below the "safe load level"<sup>xvi</sup> for the Site

- Control migration of PCE and its breakdown products to the Kanawha River to a level that is protective of surface water quality
- Protect aquatic sediments adjacent to the Site
- Achieve State and Federal groundwater cleanup criteria<sup>xvii</sup>

#### **7.1 Proposed Approval of In-place IRMs as Final Engineering Remedial Measures**

Installed IRMs address potential exposure pathways at the Site and in combination with ICs and proper procedures by all Site personnel will ensure protectiveness of HH&E. Over time, all Site CMOs can be achieved with the IRMs in place.

#### **7.2 Proposed Approval of the IM-EMP as the Final Site Monitoring Plan**

The IM-EMP will provide the Agencies with sufficient feedback on the performance of the Final Remedial Measures to be assured that HH&E are being protected and that acceptable progress is being made pursuant to achievement of Site CMOs.

#### **7.3 Proposed Installation of Containment Area P&T Extraction and Treatment System and Acceptance as Final Remedial Measure**

The containment area extraction wells are in place and the designed and approved treatment system is currently being installed. The treatment system is planned for installation/startup in 2016. The GAC treatment system will be utilized as long as it is necessary to remove water from the containment areas to be protective of HH&E. Solutia proposes to evaluate annually whether P&T is providing any additional protection to HH&E versus the containment barriers alone – without P&T. No changes will be made to the Final Remedial Measures as a result of this annual evaluation without the Agencies' approval.

#### **7.4 Proposed Continued ICs and Approval as Final Administrative Remedial Measures**

The Site administrative controls currently being developed/implemented will include: land use restrictions via restrictive covenants to limit Site activities to commercial/industrial and be protective of the installed engineering control components<sup>xviii</sup> and prohibition of groundwater extraction via restrictive covenants for any reason other than monitoring and/or treatment. Site access control in the form of security fencing and fence signage will be maintained as needed, consistent with the Site use. ICs will provide an additional level of protection for HH&E.

#### **7.5 Proposed Continued Implementation of the Site Monitoring and Maintenance Plan**

Site-wide soil covers and engineered caps require maintenance and monitoring as described in the Monitoring and Maintenance (M&M) Plan (see **Appendix G**). The ongoing maintenance and monitoring will continue through the life of the final remedy to maintain its effectiveness to protect the health and safety of any workers performing work on Site or trespassers.

## 8.0 ENDNOTES

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<sup>i</sup> The original Monsanto Company incorporated in 1901.

<sup>ii</sup> The August 7, 1995 Addendum responded to the Agencies' June 16, 1995 Comments on the May 5, 1995 RFI Report.

<sup>iii</sup> Results reported in "PDA SWMU Investigation Final Report", (Project 01-0081-120A), Potesta & Associates, Inc., dated June 2004.

<sup>iv</sup> Documentation of Environmental Indicator Determination Report", (Project 01-0081-320A), Potesta & Associates, Inc., dated December 2003.

<sup>v</sup> Expanded RFI-Groundwater Work Plan, November 2004 (01-0081-720A), Potesta & Associates, Inc.

<sup>vi</sup> Final Expanded RFI-Soils and SWMUs Work Plan (01-0081-730A), May 2006, Potesta & Associates, Inc.

<sup>vii</sup> Final Draft Expanded RCRA Facility Investigation Report (0101-01-0081-720A), February 16, 2007, Potesta & Associates, Inc.

<sup>viii</sup> "Safe Load Level" for the Site established in the Total Maximum Daily Load (TMDL) report: "Dioxin TMDL Development for Kanawha River, Pocatalico River and Armour Creek, West Virginia", dated September 14, 2000, prepared for U.S EPA Region III by Tetra-Tech, Inc.

<sup>ix</sup> Achievement of groundwater cleanup criteria will require reasonable efforts to eliminate or mitigate further releases of contaminants from SWMUs, impoundments and affected soils and reduction of contaminant levels, as practicable, over time, to support reasonably expected use. These criteria may include the implementation of institutional and/or engineering controls.

<sup>x</sup> "Final Interim Measures Work Plan", dated April 9, 2010, Potesta & Associates, Inc.

<sup>xi</sup> This is an environmental covenant executed pursuant to the Voluntary Remediation and Redevelopment Act, West Virginia Code Chapter 22, Article 22, and the Uniform Environmental Covenants Act, West Virginia Code Chapter 22, Article 22B. The environmental covenant will be acquired after all components of the remedy are constructed and all remedial components finalized. The covenant will map out all constructed engineering controls and associated use-restrictions for those specific units and for Site-wide restrictions.

<sup>xii</sup> See Endnote xi

<sup>xiii</sup> "Interim Measures Effectiveness Monitoring Plan", dated March 11, 2013, Potesta & Associates, Inc.

<sup>xiv</sup> Report 1 – Groundwater Model Development and Flow Simulations, Solutia Nitro Site, Nitro, West Virginia, by GSI Environmental Inc., Houston, Texas, dated September 9, 2011; Report 2 - Monitoring "Well Evaluation for Remediation Effectiveness", Solutia Nitro Site, Nitro, WV, by GSI Environmental Inc., Houston, Texas, dated March 11, 2013.

<sup>xv</sup> The Point of Compliance (POC) for determining an exceedance of the WQS will be in the Kanawha River within an acceptable mixing zone.

<sup>xvi</sup> See Endnote viii

<sup>xvii</sup> See Endnote ix

<sup>xviii</sup> See Endnote xi

# *APPENDIX A*

## APPENDIX A

### Historical Site Use and Ownership

The Site has been utilized for chemical production since the early 1910s. The initial production facility was developed between 1918 and 1931 by the United States Government for the production of military munitions during the World War I era. The operation was purchased by Rubber Services Company in 1921 for the manufacturing of chloride, phosphate and phenol compounds. Old Monsanto purchased the facility in 1929 from Rubber Services Company. Old Monsanto added the manufacture of flotation agents, pickling inhibitors, anti-oxidants, anti-skinning, wetting agents, and oils to the existing production operations in the 1930s.

Old Monsanto continued to expand operations at the Site and accelerated its growth in the 1940s, including the production of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) and sodium trichlorophenoxyacetic acid. A byproduct of the production of 2,4,5-T is the creation of 2,3,7,8 tetrachlorodibenzo-para-dioxin (TCDD). TCDD has been detected in surface soils at the Nitro Site. Production of the herbicide 2,4,5-T was initiated at pilot scale during the summer of 1948; plant scale production began in October 1948 in Building 34. As the demand for the herbicide increased during the Vietnam War, a new integrated facility in Building 92 was constructed and came online in August 1963. Production of the herbicide continued until demand for the product eased and production ceased at the Site in 1969. Several of the units associated with the production of the herbicide were decontaminated, demolished and buried on site during the early 1970s.

The manufacturing of rubber chemicals initially comprised about 65 percent of the Site's operations. The product line was diversified with new additions over the years, including the aforementioned herbicide production and an animal feed nutritional additive in addition to rubber chemicals including vulcanization accelerators, vulcanization inhibitors and anti-oxidants for miscellaneous rubber products. A variety of raw materials were used in the multiple chemical production processes carried out at the Site over the years, including inorganic compounds, organic solvents, and other organic compounds.

All production operations, maintenance and facility management of the Nitro plant were transferred from Old Monsanto to Flexsys in 1995. This transfer agreement included the entire Site and substantially all of the assets except the improved real estate and certain limited manufacturing assets. The Site Resource Conservation and Recovery Act (RCRA) Permit was modified (Class I modification) to reflect the change in permittee status from Old Monsanto to both Old Monsanto and Flexsys. In 1997, Old Monsanto spun off its chemical businesses to a newly created company called Solutia. The equity acquired by Solutia included Old Monsanto's interest in Flexsys, including the Nitro facility, as well as Old Monsanto's solely owned assets and liabilities at the Nitro Site. Assets included the real Site property while liabilities included responsibility for RCRA Corrective Action.

In October 2003 Flexsys made a business decision to cease all chemical production at the Nitro facility. Activities began during the second quarter of 2004 to dismantle, decontaminate, and remove all surface structures including the wastewater treatment plant facility. Demolition was completed in December 2005.

# ***APPENDIX B***

## DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

Interim Final 2/5/99

### RCRA Corrective Action Environmental Indicator (EI) RCRIS Code (CA750)

#### Migration of Contaminated Groundwater Under Control

**Facility Name:** Flexsys America L.P. Facility (*Solutia Inc.*)  
**Facility Address:** No. 1 Monsanto Rd., Nitro, WV 25143  
**Facility EPA ID#:** WVD039990965

1. Has **all** available relevant/significant information on known and reasonable suspected releases to the groundwater media, subject to RCRA Corrective Action (e.g., from Solid Waste Management Units (SWMU), Regulated Units (RU), and Areas of Concern (AOC)), been **considered** in this EI determination?

  X   If yes – check here and continue with #2 below.

       If no – re-evaluate existing data, or

       If data are not available, skip to #8 and enter “IN” (more information needed) statue code.

This CA750 Groundwater Environmental Indicator Report (EIR) is based on information collected during completion of an investigation and evaluation of groundwater resources throughout the Flexsys America L.P. facility (Figure 1). Areas investigated and included in the EIR are the internal portions of the plant process area (PA) as well as the wastewater treatment area (WWTA). In addition, sediment and surface water sampling in the Kanawha River downgradient of the Flexsys facility was also conducted to provide the information needed to prepare this report.

#### Summary of Groundwater Investigation

This investigation included the advancement of a total of 102 individual temporary groundwater sampling direct push points. Three samples were collected at each of 34 locations throughout the facility limits providing grab samples from three zones within the unconsolidated aquifer beneath the site. These sampling horizons generally adhered to the following depths.

- ◆ Zone A: Phreatic surface sampling points, generally located at a depth of 25 to 30 feet below the ground surface.
- ◆ Zone B: Mid Aquifer sampling points, located at a midpoint in the unconsolidated aquifer between the phreatic surface and the bedrock horizon.
- ◆ Zone C: Basal Aquifer sampling points, located at the bedrock interface, generally located at depths ranging from 55 to 60 feet below the ground surface.

### **Summary of Sediment and Surface Water Investigation**

Several additional investigations were completed during of the data collection phase of this EIR investigation. These included the collection of both sediment and surface water samples from the Kanawha River immediately adjacent to the western boundary of the Flexsys facility. The first round of sampling was completed in September 2001 and included the collection of surface water and sediment samples from three individual sections of the river at the Flexsys property. After submittal of these results, the USEPA requested that a second sampling event be completed to fill data gaps, and that this scope of work include the collection of both sediment and surface water samples from the entire boundary limit. Additionally, dioxin/furan testing was also added to the parameter listing. This work was completed in December 2002.

### **Data Report and Data Validation Report**

Two additional reports are provided as supplements to this Environmental Indicator Report. These include a Data Report and a Data Validation Report. These provide information and details related to the field investigation as well as results of the analytical testing completed during this study.

The Data Report contains a summary of the data collected during the field investigation including tables summarizing the analytical tests conducted on the collected groundwater, sediment and surface water samples.

The Data Validation Report contains a summary of the results of the data quality validation completed on the recently collected analytical data. At the request of the USEPA-Region III, 100 percent of the data collected underwent validation after review of Level 4 data packages received from the analytical laboratories.

### **Summary of Results**

Results of the CA-750 Groundwater EIR Investigation are summarized in a series of figures, listed below; they are attached to the EIR and are also included in the Data Report.

- Figure 1 Site Plan
- Figure 2 Groundwater Elevations
- Figure 3 Contaminant Plume Boundary
- Figure 4 Total VOC Concentrations
- Figure 5 Total SVOC Concentrations
- Figure 6 Total Herbicide Concentrations
- Figure 7 Dioxin TEQ Concentrations

These figures indicate the location of the various sampling points in addition to a graphic presentation of the qualitative results.

2. Is **groundwater** known or reasonably suspected to be “**contaminated**”<sup>1</sup> above appropriately protective “levels” (i.e., applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action, anywhere at, or from, the facility?

  X   If yes – continue after identifying key contaminants, citing appropriate “levels,” and referencing supporting documentation.

       If no – skip to #8 and enter “YE” status code, after citing appropriate “levels,” and referencing supporting documentation to demonstrate that groundwater is not “contaminated.”

       If unknown – skip to #8 and enter “IN” status code.

### **Rationale and References(s)**

The sampling efforts which were completed during this study served to systematically collect representative grab samples of groundwater to identify contaminants of potential concern (COPC). The following target analytes were part of the parameter list for each groundwater sample collected at the site:

- ◆ Target Compound List (TCL) VOCs
- ◆ TCL SVOCs, plus Aniline, Ethyl Parathion and N-Nitrosodiphenylamine
- ◆ Appendix IX Chlorinated Herbicides (2,4-D, 2,4,5-T and 2,4,5-TP {Silvex})
- ◆ TCL Chlorinated Dibenzo-p-dioxin/Dibenzofuran Congeners
- ◆ TAL Metals

All groundwater and surface water results were screened against the West Virginia Water Quality Standards (46 CSR 1: Requirements Governing Water Quality Standards). These standards are commonly referred to as the Ambient Water Quality Criteria (AWQC). Since the receptor for the site groundwater is the Kanawha River, the groundwater results were compared to the AWQC level for each constituent after applying a multiplier of 10 for dilution at the river discharge location. The AWQC regulations are presented in a number of categories, each applying to a specific type of exposure scenario for the potential receptor or pertaining to the use and type of receiving stream. The following were considered appropriate AWQC screening categories, as they apply to the current designations for the Kanawha River:

Category B1: Warm Water Fishery Streams

Category B4: Wetlands

Category C: Water Contact Recreation

The AWQC regulatory limits for each of the categories were reviewed for each of the constituents of concern. The lowest AWQC value for each constituent was used in the screening procedure.

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<sup>1</sup> “Contamination” and “contaminated” describes media containing contaminants (in any form, NAPL and/or dissolved, vapors, or solids, that are subject to RCRA) in concentrations in excess of appropriated “levels” (appropriate for the protection of the groundwater resource and its beneficial uses.)

Review of the inorganic results included a comparison to limited available historic background data for the regional alluvial aquifer. This information was obtained from historic database files maintained by the United States Geologic Survey – Department of Water Resources (USGS-DWR). The data included analytical results collected from a single sampling event of nine individual wells. All of these wells were located within the Kanawha River alluvial aquifer and were relatively close to the site. Since there is no known historical source of inorganic contamination at this site, it is concluded that the inorganic constituents of concern are likely attributed to naturally occurring, regional background concentrations or the migration of contamination from upgradient, offsite sources. However, additional work will be required to determine adequate regional background levels in groundwater for inorganic constituents. This work will be completed during a future study of the site and will be documented in the preparation of an additional submittal related to this CA-750 investigation. The determination of adequate background concentrations, as well as confirmation of the limited amount existing site data for inorganic constituents, will be considered during the completion of this future work.

The following summary presents maximum analytical results for groundwater samples collected during this investigation that were in excess of the benchmark AWQC screening levels.

<u>Class</u>	<u>Constituent</u>	<u>Maximum Conc.</u> (ug/l)	<u>Screening Value</u> <u>(10xAWQC)</u> (ug/l)
<b>Volatile Organics</b>	1,1-Dichloroethane	210	32
	Carbon Tetrachloride	830	44
	Halomethanes	130	15.7
	Vinyl Chloride	17,000	5250
	Trichloroethene	14,000	810
	Tetrachloroethene	12,000	88.5
<b>Semivolatile Organics</b>	Total PAHs	160	0.031
	Phthalate Esters	290	3
<b>Dioxins/Furans</b>	2,3,7,8-TCDD	42 pg/l	0.14 pg/l

Table 1, located at the end of this document, shows the sampling location for each groundwater sample constituent concentration is excess of the screening value.

Groundwater at the northern and southern boundaries of both the PA and the WWTA do not discharge directly to the Kanawha River. At these locations, the appropriate screening criterion is the state Groundwater Protection Standard. Therefore, groundwater analytical results obtained from those monitoring points established at the northern and southern boundaries of both the PA and the WWTA were screened against the West Virginia Groundwater Protection Regulation Standards, (46 CSR 12: Requirements Governing Groundwater Standards). Results are discussed more thoroughly in response to the following Question 3.

There were no exceedances of any AWQC for any surface water constituent in the Kanawha River surface water samples.

3. Has the **migration** of contaminated groundwater **stabilized** (such that contaminated groundwater is expected to remain within “existing area of contaminated groundwater”<sup>2</sup> as defined by the monitoring locations designated at the time of this determination?

\_\_\_\_\_ If yes – continue, after presenting or referencing the physical evidence (e.g., groundwater sampling/measurement/migration barrier data) and rationale why contaminated groundwater is expected to remain within the (horizontal or vertical) dimension of the “existing areas of groundwater contamination”<sup>2</sup>).

\_\_\_\_\_ If no (contaminated groundwater is observed or expected to migrate beyond the designated locations defining the “existing area of groundwater contamination”<sup>2</sup>) – skip to #8 and enter “NO” status code, after providing an explanation.

  X   If unknown – skip to #8 and enter “IN” status code.

#### **Rationale and Reference(s)**

The groundwater flow directions at the site clearly are in a west-northwest direction and generally toward the Kanawha River; however, several localized areas of groundwater flow could migrate outside the property limits prior to discharge to the river (Figure 2). The potentiometric surfaces generated and presented in the supportive information to this questionnaire were developed from groundwater gauging information collected in the facilities groundwater existing groundwater monitoring well network.

The body of data existing prior to this CA-750 investigation and the information collected during this CA-750 investigation remains insufficient to adequately delineate the northern and southern plume boundaries. Constituent concentrations at the site boundaries in the PPA and the WWTa exceed the West Virginia Groundwater Protection Act screening criteria (46 CSR 12: Requirements Governing Groundwater Standards); therefore, existing areas of impacted groundwater (Figures 3, 4, 5 and 6) cannot be verifiably demonstrated to contain all impacted groundwater. Additional investigation of these border areas must be completed before a final EI determination can be made for the site.

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<sup>2</sup> “existing area of contaminated groundwater” is an area (with horizontal and vertical dimensions) that has been verifiably demonstrated to contain all relevant groundwater contamination for this determination, and is defined by designated (monitoring) locations proximate to the outer perimeter of “contamination” that can and will be sampled/tested in the future to physically verify that all “contaminated” groundwater remains within these areas, and that the further migration of “contaminated” groundwater is not occurring. Reasonable allowances in the proximity of the monitoring locations are permissible to incorporate formal remedy decisions (i.e., including public participation) allowing a limited area for natural attenuation.

4. Does “contaminated” groundwater **discharge** into **surface water** bodies?

  X   If yes – continue after identifying potentially affected surface water bodies.

       If no – skip to #7 (and enter a “YE” status code in #8, if #7 = yes) after providing an explanation and/or referencing documentation supporting that groundwater “contamination” does not enter surface water bodies.

       If unknown – skip to #8 and enter “IN” status code.

**Rationale and References(s)**

Groundwater flow at the site (Figure 2) is toward the west-northwest. Based on the observed flow direction to the west-northwest, the horizontal extent of plume migration in groundwater is limited by the Kanawha River, which is located adjacent to the western boundary of the site providing a physical limit to migration of impacted groundwater (Figure 3).

5. Is the **discharge** of “contaminated” groundwater into surface water likely to be “**insignificant**” (i.e., the maximum concentration<sup>3</sup> of each contaminant discharging into surface water is less than 10 times their appropriate groundwater “level,” and there are no other conditions (e.g., the nature, and number, of discharging contaminants, or environmental setting), which significantly increase the potential for unacceptable impacts to surface water, sediments, or eco-systems at these concentrations)?

  X   If yes – skip to #7 (and enter “YE” status code in #8 if #7 – yes), after documenting: 1) the maximum known or reasonable suspected concentration<sup>3</sup> of key contaminants discharged above their groundwater “level,” the value of the appropriate “level(s),” and if there is evidence that the concentrations are increasing; and 2) provide a statement of professional judgment/explanation (or reference documentation) supporting that the discharge of groundwater contaminants into the surface water is not anticipated to have unacceptable impacts to the receiving surface water, sediments, or eco-system.

       If no – (the discharge of “contaminated” groundwater into surface water is potentially significant” – continue after documenting: 1) the maximum known or reasonably suspected concentration<sup>3</sup> of each contaminant discharged above its groundwater “level,” the value of the appropriate “level(s),” and if there is evidence that the concentrations are increasing; and 2) for any contaminants discharging into surface water in concentrations<sup>3</sup> greater than 100 times their appropriate groundwater “levels; the estimated total amount (mass in kg/yr) of each of these contaminants that are being discharged (loaded) into the surface water body (at the time of the determination), and identify if there is evidence that the amount of discharging contaminants is increasing.

       If unknown – enter “IN” status code in #8.

### **Rationale and Reference(s)**

None of the results from the collected surface water samples exceeded the appropriate Ambient Water Quality Criteria. Therefore, the discharge of contaminated groundwater along the site boundary at the Kanawha River does not cause an exceedance of the standard (AWQC); therefore, is considered to be insignificant. The following table is provided to show the relationship between the concentrations of the various constituents of concern detected in the collected groundwater samples and those constituent concentrations resulting from the surface water samples collected from the Kanawha River. For reference, the appropriate screening criteria, AWQC is also included in the table for comparison.

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<sup>3</sup> As measured in groundwater prior to entry to the groundwater-surface water/sediment interaction (e.g., hyporheic) zone.

### SURFACE WATER RESULTS VS. AWQC

Chemical Constituent	Surface Water Maximum Detected (ug/l)	AWQC (ug/l)
1,1-Dichloroethene	N/A	3.2
Carbon tetrachloride	1.2	4.4
Vinyl chloride	1.1	525
Trichloroethene	3.5	81
Tetrachloroethene	N/A	8.85
PAH	N/A	0.031
Halomethanes	N/A	15.7
Phthalate esters	N/A	3.0

N/A *These compounds were not analyzed for in the laboratory analyte listing approved as presented in the sampling and analysis work plan document.*

6. Can the **discharge** of “contaminated” groundwater into surface water be shown to be “**currently acceptable**” (i.e., not cause impacts to surface water, sediments or eco-systems that should not be allowed to continue until a final remedy decision can be made and implemented<sup>4</sup>)?

  X   If yes – continue after either: 1) identifying the Final Remedy decision incorporating these conditions or other site-specific criteria (developed for the protection of the site’s surface water, sediments, and eco-systems), and referencing supporting documentation demonstrating that these criteria are not exceeded by the discharging groundwater; OR 2) providing or referencing an interim-assessment,<sup>5</sup> appropriate to the potential for impact, that shows the discharge of groundwater contaminants into the surface water is (in the opinion of a trained specialists, including ecologist) adequately protective of receiving surface water, sediments, and eco-systems, until such time when a full assessment and final remedy decision can be made. Factors which should be considered in the interim-assessment (where appropriate to help identify the impact associated with discharging groundwater ) include: surface water body size, flow, use/classification/habitats and contaminant loading limits, other sources of surface water/sediment contamination, surface water and sediment sample results and comparisons to available and appropriate surface water and sediment “levels,” as well as only other factors, such as effects on ecological receptor (e.g., via bio-assays/benthic surveys or site-specific ecological Risk Assessments), that the overseeing regulatory agency would deem appropriate for making the EI determination.

       If no – (the discharge of “contaminated” groundwater can not be shown to be “**currently acceptable**”) – skip to #8 and enter “NO” status code, after documenting the currently unacceptable impacts to the surface water body, sediments, and /or eco-systems.

       If unknown – skip to #8 and enter “IN” status code.

### **Rationale and Reference(s)**

The results of the surface water screening to the AWQC values (Table 2) shows that the discharge of groundwater into the surface water is adequately protective of receiving surface water because surface water sampling indicates that AWQC are not exceeded. The current designation for the Kanawha River prevents its use as a potable drinking water resource and the current fish consumption advisory discourages the consumption of bottom feeding fish.

<sup>4</sup> *Note, because areas of inflowing groundwater can be critical habitats (e.g., nurseries or thermal refugia) for many species, appropriate specialist (e.g., ecologist) should be included in management decisions that could eliminate these areas by significantly altering or reversing groundwater flow pathways near surface water bodies.*

<sup>5</sup> *The understanding of the impacts of contaminated groundwater discharges into surface water bodies is a rapidly developing field and reviewers are encouraged to look to the latest guidance for the appropriate methods and scale of demonstration to be reasonably certain that discharges are not causing currently unacceptable impacts to the surface waters, sediment or eco-systems.*

These factors minimize any immediate threat that the site may present to the general public. For these reasons, it is considered currently acceptable to allow site groundwater to continue to discharge to surface water until a final remedy decision can be made and implemented.

7. Will groundwater **monitoring**/measurement data (and surface water/sediment/ecological data, as necessary) be collected in the future to verify that contaminated groundwater has remained within the horizontal (or vertical, as necessary) dimensions of the “existing area of contaminated groundwater?”

  X   If yes – continue after providing or citing documentation for planned activities or future sampling/measurement events. Specifically identify the well/measurement locations which will be tested in the future to verify the expectation (identified in #3) that groundwater contamination will not be migrating horizontally (or vertically, as necessary) beyond the “existing area of groundwater contamination.”

       If no – enter “NO” status code in #8.

       If unknown – enter “IN” status code in #8.

#### **Rationale and Reference(s)**

Additional work associated with the delineation of the northern and southern boundary plume limits will be conducted in the future. The work associated with this will be detailed in a future work plan to be developed in the first quarter of 2004 and submitted to the USEPA for approval prior to starting the work. The data collected will be utilized to supplement the information collected and presented in this submittal. Following collection and study of this future data, an updated CA-750 Environmental Indicator Report will be prepared and submitted to the USEPA.

8. Check the appropriate RCRIS status codes for the Migration of Contaminated Groundwater Under Control EI (event code CA750), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (attach appropriate supporting documentation as well as a map of the facility).

\_\_\_\_\_ YE – Yes, "Migration of Contaminated Groundwater Under Control" has been verified. Based on a review of the information contained in this EI determination, it has been determined that the "Migration of Contaminated Groundwater." This determination will be re-evaluated when the Agency becomes aware of significant changes at the facility.

\_\_\_\_\_ NO – Unacceptable migration of contaminated groundwater is observed or expected.

  X   IN – More information is needed to make a determination.

Completed by (signature) \_\_\_\_\_

Date \_\_\_\_\_

(print) Mr. Michael L. House

(title) Manager, Remedial Projects (Solutia Inc.)

Supervisor (signature) \_\_\_\_\_

Date \_\_\_\_\_

(print) \_\_\_\_\_

(title) \_\_\_\_\_

(EPA Region/State) Region III/West Virginia

### **Locations Where References May Be Found**

- Geraghty & Miller, Inc., 1985. Groundwater Assessment – Waste Water Treatment Plant, May 1985.
- Geraghty & Miller, Inc., 1985. Groundwater-Water Quality Investigation at the Monsanto Plant, October 1985.
- Roux Associates, Inc., 1993. Revised Final Verification Investigation Report, August 24, 1993.
- Roux Associates, Inc., 1994. Facility Sewer System Stabilization Work Plan Evaluation Study, August 5, 1994.
- Roux Associates, Inc., 1995. RFI Report and Stabilization/Corrective Measures Plan, May 5, 1995.
- Roux Associates, Inc., 1995a. Sewer Stabilization Measures Evaluation Report, May 30, 1995.
- Roux Associates, Inc., 1995b. Addendum to the RCRA RFI/CMS Plan, August 7, 1995.
- Roux Associates, Inc., 1996. Stabilization/Corrective Measures Study Report, February 29, 1996.
- Roux Associates, Inc., 1996. Detailed Sewer Stabilization Measures Plan, November 27, 1996.
- Roux Associates, Inc., 1998. Summary of Ground-Water Sampling and LNAPL Monitoring Data, September 25, 1998.
- Roux Associates, Inc., 1999. Stabilization/Corrective Measures Effectiveness Report, January 25, 1999.
- Roux Associates, Inc., 2000. Response to USEPA Comments of Corrective Measures Effectiveness Report, May 12, 2000.
- Roux Associates, Inc., 2001. Corrective Measures Study Work Plan, March 26, 2001.
- Roux Associates, Inc., 2001. Evaluation of Environmental Indicator for Migration of Contaminated Ground-Water Under Control – RCRIS Code CA750, Solutia, Inc. Facility, December 2001.
- Roux Associates, Inc., 2001. Report on Phase IA Activities, December 28, 2001.
- Potesta & Associates, Inc., 2003. Site Assessment Work Plan – Final, CA-750 Groundwater Characterization Investigation, May, 2003.

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# ***APPENDIX C***

## **APENDIX C**

### **Stabilization Measures Preceding IRMs**

The stabilization measures listed below were completed prior to initiation of the Interim Remedial Measures discussed in this Corrective Measures Study (all prior to 2004) including: closure of some SWMUs and surface impoundments; stabilization of waste disposal areas; and additional actions to control stormwater and groundwater migration pursuant to the RCRA Corrective Action Permit (EPA ID. No. WVD039990965).

- SWMU closures in the WTA
  - SWMU 8 - 0.5-acre waste pond
  - SWMU 10 - Surge Basin
  - SWMU 12 - Limestone bed
  - SWMU 11 - 5 million gallon Equalization Basin
  - SWMU 13 - 10 million gallon Emergency Basin
  - A3 Basin
  - SWMU 14 - Waste Treatment Plant – consisting of the 2-million-gallon Activated Sludge Basin, Secondary and Tertiary Clarifiers, and Digester
- Closure of SWMU 4 - four aboveground Equalization/Stormwater Surge Tanks in the PA
- Closure of SWMU 5 - Sitewide combination process/stormwater sewer closed, stabilized and isolated
- Closure of SWMUs 1, 2, 3 and 6 - PDA stabilization
- Riverbank slough stabilization
- Additional projects including:
  - Sitewide Stormwater migration controls
  - Sitewide Groundwater migration controls
  - LNAPL migration control in the PDA

## **1.0 SOURCE CONTROL INTERIM CORRECTIVE MEASURES**

### **1.1 SWMU Closures**

#### **1.1.1 Waste Pond Closure**

This basin was an approximately 0.5-acre surface impoundment with the capacity to store approximately 1 million gallons of wastewater and sludge. The pond was constructed in native soils and is not known to have been lined. The Waste Pond began operation in 1973 and was closed in 1980 when it was clay-capped and vegetated.

### **1.1.2 Limestone Bed Closure**

The Limestone Bed was charged with limestone aggregate and utilized to adjust pH of the inflow to the WWTU from the process sewer. This facility was constructed in 1977 and was asphalt lined. Following the installation of inline pH adjustment equipment at the WWTU during the summer of 1986, the limestone bed was closed in December 1986. Prior to closure, the impounded water in the Limestone Bed was pumped from the facility and discharged to the WWTU trim basin for treatment along with some of the highly saturated portions of the sludge. Following the dewatering of the basin, four samples were collected from the remaining sludge; these samples were analyzed for pH. The results of the four samples collected indicated pH values ranging from 7.7 to 7.8 S.U., confirming the non-hazardous status of the material. The remaining non-hazardous sludge (approximately 3,000 cubic yards) was placed in the Armour Creek Landfill Nine Cell. The remaining soil containment berms around the basin were then graded into the basin to create a level area, and covered with gravel.

### **1.1.3 Equalization Basin Closure**

The Equalization (EQ) Basin was utilized for pH adjustment and mixing of the process wastewater prior to discharge to the activated sludge basin at the WWTU. This basin, which measured approximately 540 feet by 137 feet (5 million gallon capacity) was lined with an asphalt emulsion. The EQ Basin was initially closed under a RCRA closure plan in 1986 which included sludge sampling to determine if the material was characteristically hazardous due to corrosivity ( $\text{pH} > 12.5$ ). The results of this sampling indicated that the material was not hazardous and this unit continued to be utilized for wastewater storage associated with the WWTU until it was stabilized in-place between September 1989 and April 1990. This final closure effort utilized a mixture of Portland cement and off site borrow soils to stabilize the sludge. The basin liner was removed from the side slopes of the basin. The stored water was decanted from the underlying sludge and pumped to the wastewater treatment facility for processing. The sludge was mixed with soil initially as a bulking and drying agent followed by solidification/stabilization using injectors fitted to the track mounted excavators to introduce Portland cement. Records indicate that approximately 23,000 CY of sludge was stabilized in this basin. Following stabilization, the remaining volume was backfilled with clean borrow soils and vegetated.

### **1.1.4 Emergency Basin Closure**

The Emergency Basin was constructed and began operation in 1963. It was approximately 385 feet by 395 feet, having a capacity of approximately 10 million gallons. This basin was utilized for process wastewater streams that were unusually high in pH or organic concentration. The process wastewater from the Emergency Basin was fed to the equalization basin in a controlled manner so that biological treatment could continue to function efficiently. The Emergency Basin was closed and stabilized in May 1990 thru October 1990. The stabilization technology and approach were the same as utilized on the Equalization Basin. However, based on the nature and consistency of the sludge contained in this basin, fly ash was also determined to be a more

economical and effective bulking and drying reagent and was added prior to injection of Portland cement. The amount of sludge contained in this basin is unknown.

#### **1.1.5 Aboveground Equalization/Stormwater Tank Closures**

The Aboveground Equalization/Stormwater Surge Tanks were cleaned, dismantled and disposed by Flexsys pursuant to the facility demolition plan. This SWMU was located within the boundaries of the PDA SWMU near its southern boundary with the PA. The original construction of these tanks included the installation of a geotextile marker overlain with several feet of clean fill placed over the PDA surface soils. The tank foundations were then constructed within the limits of this fill material, preventing the need for excavation or disturbance of the underlying PDA soils. The structures and associated piping were dismantled to grade, decontaminated and removed from the site by the demolition contractor without disturbance of the fill or geotextile marker.

#### **1.1.6 Sewer System Closure**

Solutia, Flexsys and the Agencies (Parties) reached an agreement in 1995 on how the Facility Sewer System SWMU would be addressed. The agreement among the Parties was based on the following documents:

- “Facility Sewer System Stabilization Work Plan,” Roux Associates, Inc. August 5, 1994.
- “Sewer Stabilization Measures Evaluation Report,” Roux Associates, Inc., May 30, 1995. This report presented a comparative analysis of conceptual sewer stabilization measures alternatives.
- “Detailed Sewer Stabilization Measures Plan,” Roux Associates, Inc., November 27, 1996.

The Parties agreed that Flexsys would fund an estimated \$25 million Stabilization Measure to install above grade process sewers, eliminating the use of the below grade Facility Sewer System for process wastewater streams, in lieu of further characterization and investigation of the Facility Sewer System SWMU. Installation of this Stabilization Measure pursuant to the November 27, 1996 Work Plan was nearing completion when the decision was made by Flexsys in October 2003 to discontinue operations at its Nitro facility. The Facility Sewer System SWMU was closed and isolated in place by sealing all outfalls and drop inlets with concrete during facility demolition. The physical closure of the Facility Sewer System SWMU was photographically documented.

#### **1.1.7 Waste Water Treatment Plant Closure**

The Wastewater Treatment Plant SWMU, consisting of the Activated Sludge Basin, the Secondary Clarifier and the Tertiary Clarifier, was dismantled to grade in 2005 pursuant to the Flexsys facility demolition plan. The Secondary and Tertiary Clarifiers were cleaned,

dismantled and disposed off site. The Activated Sludge Basin was a 2 million gallon primarily sub grade, open top, concrete basin. The basin was cleaned, dismantled to grade, filled with soil, covered with topsoil and vegetated.

## **1.2 Surface Impoundment Closures**

### **1.2.1 Waste Water Treatment Plant Digester Closure**

The Wastewater Treatment Plant Digester was located along the northwest corner of the A3 basin. The facility contained several aerial walkways and platforms supporting mixers. The mixers provided preliminary treatment and digestion of wastewater treatment facility sludges and organic rich process water prior to introduction into the biological treatment unit.

The Digester was closed during the period 5/90 through 9/90. The sludges were dewatered with excavating pump to remove standing water. The water was discharged to the activated sludge basin. Following dewatering, the sludges were excavated and transferred to the adjacent A3 basin where they were stabilized and solidified along with the A3 sludges. The resulting basin was then backfilled with compacted clean borrow soils from an undisturbed area located immediately to the east of the basin.

### **1.2.2 A3 Basin Closure**

The A3 basin was the largest of the surface basins existing at the wastewater treatment facility. This impoundment was used for storage and mixing of process wastewater prior to treatment in the wastewater treatment facility activated sludge basin. Stabilization of this basin was completed during the period of September 1996 through March 1997. A mixture of Site soils and lime kiln dust was utilized to stabilize the sludge. The soils were obtained from an adjacent borrow area and used to bulk the saturated sludges prior to the introduction of the lime kiln dust. The kiln dust was batch mixed using an excavator to reduce the volume and to stabilize the sludge. Following stabilization, the sludge was graded, covered with 12 inches of soil and vegetated. Surface water from the basin was directed to the river via a channel created by the borrow soil excavation.

## **1.3 Disposal Area Stabilization**

### **1.3.1 Past Disposal Area**

The PDA encompasses approximately 10.5 acres and is located in the northern portion of the plant process area adjacent to the Kanawha River. The area was designated as a SWMU in the 1990 RFA. Two additional SWMUs were located within the limits of the PDA: the Niran Waste Pits and the Teepee Incinerator. Prior to closure and demolition of the Flexsys Nitro Plant in 2004-2005, the PDA area was utilized for the storage of salvage materials generated from demolition and retrofitting activities in various areas of the plant facility. The entire area was closed, and the ground surface was covered by a layer of gravel in 1985 as part of a Consent Agreement with the USEPA Region III (III-85-17-DC). Surface water from the PDA is

prevented from discharging off the Site property limits and onto the adjacent West Virginia Alcohol Beverage Control Administration (WVABCA) property by a site boundary perimeter berm constructed from soil. This berm runs along the entire eastern boundary of the PDA separating the PDA and the WVABCA property.

### **1.3.2 Riverbank Slough Stabilization**

A routine site inspection conducted by the WVDEP on March 6, 2002, identified an unstable area along the Kanawha River bank in the vicinity of the PDA. Solutia was notified of the results of this inspection which included visual observation of a black to brown residue material within the limits of the failed sections of the bank. It was noted that the material appeared to flow from the bank and that the material had entered the river at one location. Solutia conducted site reconnaissance of the area and collected samples of the residue on March 15, 2002. The composition of the material was determined to be similar in makeup to Sodium MBT pitch, a waste product from the Flexsys plant operations. The analytical results from these residue samples indicated the presence of aniline and N-Nitrosodiphenylamine (associated with NaMBT production); Methylene Chloride; and low levels of 2,3,7,8,-TCDD. Following disclosure of the initial inspection by the WVDEP, Solutia provided formal notification of the release to USEPA on April 15, 2002.

A formal interim measures work plan was prepared by Solutia and submitted to the USEPA on August 2, 2002. The work plan included the collection of sediment core samples from the Kanawha River adjacent to the areas of concern to determine if the residue had contaminated river sediments. A total of 18 sediment core samples were collected with depths ranging from 4 to 20 inches. The sediment samples were visually observed for the presence of residue. The collected samples appeared clean with no discernable evidence of residue.

A regrading and stabilization plan was prepared, starting with the collection of site survey information, followed by the excavation and removal of the failed soil mass, which included removal of the residue seepage material. The material was removed, placed in rolloff boxes for temporary storage and placed within an enclosed HDPE "envelope" in the A3 Basin. During the completion of this work, air perimeter monitoring was conducted as well as the excavation of several test pits throughout the area to collect soil samples for analytical testing. Visual observations of the exposed slide scarp indicated that the residue noted in the initial site inspection was limited to a localized, relatively thin (2- to 4-inch) seam that existed beneath the surficial construction demolition material that had been placed along the riverbank. Following removal of the failed soil materials and residue, the exposed slope was sampled to confirm that residue had been removed from the exposed slope subgrade.

Following the confirmatory sampling, a geotextile fabric was placed on the face of the bank in the work area. An excavator was utilized to place stone riprap and stone backfill on the top of the fabric. The disturbed areas above the riprap along the top of the slope were seeded and mulched. The analytical results and a detailed description of the completed work are summarized in a report entitled, "Interim Measures-Final Report, Kanawha Riverbank Stabilization and Residue Cleanup, Flexsys Nitro Plan Facility, MP 42.1," dated February 2004.

## **2.0 MIGRATION CONTROLS**

### **2.1 Stormwater Migration Control**

Following isolation of the Site subgrade Facility Sewer System SWMU in June 2005 as described above, an Interim Measures Work Plan for Stormwater management pursuant to both the Solutia NPDES Permit and the Solutia RCRA Corrective Action permit Section E.2; "Interim Measures," was submitted to the Agencies for review and approval. The objective of this Interim Corrective Measure was to manage Site stormwater runoff post-demolition (i.e., following decommissioning and dismantling of all operational facilities).

Solutia completed an assessment of stormwater hydrology conditions for the Site to estimate the amount and flow patterns of stormwater runoff within the property boundaries. These results were utilized to assess the effects of alternative stormwater control measures for the Site such as internal levees and berms with respect to ponding, infiltration, sediment transport and direct runoff from the Site to the Kanawha River. The stormwater hydrologic assessment for the Site consisted of drainage pattern definition, determination of flow types and pathways, analysis and review of ground cover types, and assignment of runoff curve numbers.

This information was used in a stormwater runoff computer model to estimate the quantity of runoff for the PA and the WWTU. Technical Release 55, Urban Hydrology for Small Watersheds, developed by the US Soil Conservation Service was the computer model utilized. The model provides storm runoff volumes as well as the peak rate of discharge for relatively small, urbanized or developed watersheds. This model was well suited for this application given the amount of development and disturbance on the Site and the size of the study area.

In order to better understand the topographic features of the Site as well as the proximity and locations of the various drainage controls and conveyance structures, a detailed topographic map of the property was developed using aerial photography obtained on September 24, 2003. Ground control surveys of mapping panel points were prepared by survey personnel in support of this effort. Aerial photography was obtained at two separate altitudes with differing accuracies to aid in the development of mapping. Since the study would be concentrated primarily within the boundaries of the Site and the topographic relief within the plant is relatively slight, this section of the mapping was developed with a relatively high degree of accuracy (contour interval of 0.5 foot). The areas surrounding the plant are also critical to the success of the study given their contributions to stormwater runoff entering the Site. However, the precision for the mapping for the surrounding area was not as critical and was therefore produced with a contour interval of 1 foot.

Field technicians verified subtle terrain features and made additional detailed notes on the mapping. This information included the location of drainage swales, ditches and other details such as edges of pavement and curbing that will ultimately impede overland flow or runoff. All of this information was placed on the mapping prior to development of the computer model. Additional information related to such items as watershed boundaries, areas of off site run-on contribution to the Site and physical features such as existing manholes, drop inlets, and catch

basins which were not detected by the mapping were noted during the Site visit. Ground cover types and extent were also reviewed in the field prior to development of the model.

The topographic low areas associated with the closed Facility Sewer System drop inlets now pond water during storm events. During the field reconnaissance, these low areas were defined and the contributing watersheds delineated. For the PA this resulted in the delineation of a total of five separate watersheds. Each of these five areas contains an area of ponding associated with the topographic lows. During a rainfall event, each of these ponded areas fills and then flows to the next lower ponded area. This ponding and overflow cycle is repeated until the lowest areas on the property fill with water. Excess water is directed off site to the Kanawha River via a newly constructed stormwater drainway.

The Stormwater Management Interim Corrective Measure consisted of the following elements:

- A berm was constructed along the northern boundary of the PA to prevent stormwater from flowing onto the property owned by the WVABCA.
- Areas of the PA and the WWTU with existing crushed stone surfacing were evaluated. Areas where the stone thickness was less than 3 inches were covered with additional #. 57 stone to result in a stone thickness of at least 3 inches.
- Areas of the PA and WWTU where bare soil was exposed from demolition activities or other disturbance were either revegetated or covered with a 3-inch thick layer of # 57 stone.
- Areas covered by vegetation remained in their current condition. These areas are regularly inspected and maintained through routine seasonal mowing.
- Paved areas including roadway and parking areas, and building slabs (concrete floor slabs) were retained in-tact after demolition to serve as an impervious surface treatment.
- A stormwater storage and conveyance structure was constructed on the west-central portion of the PA to collect and convey stormwater from the PA to the Kanawha River, utilizing Flexsys PA Stormwater Outfall 008, renamed to PA Stormwater Outfall 001 on the new Solutia NPDES Permit.

The Solutia NPDES Permit became effective on August 30, 2005, for the PA and on November 23, 2005, for the WWTU following implementation of the Interim Measure Work Plan for Stormwater management for each Site area. The Stormwater analytical database being generated since that point, pursuant to the Site NPDES Permit requirements, is relevant to the environmental Site characterization database. The stormwater analytical results will be presented and discussed in Section 6.3.1 "Area 1-Protect the River," pursuant to the potential soils-to-surface water migration pathway for any relevant COCs.

## **2.2 Groundwater Migration Control**

During the mid-1990s, detections of TCE were noted in several of the groundwater monitoring wells located along the Kanawha River bank within the PA. Groundwater monitoring results are documented in the RFI Report. Based on this information, groundwater recovery wells were installed in the areas with elevated TCE levels along the riverbank in September 1996. A total of seven wells were installed at four locations along the riverbank based on the RFI groundwater TCE results. The wells were utilized to extract groundwater from the shallow and deep aquifer zones. The extracted groundwater was discharged to the facility process sewer for treatment at the wastewater treatment facility. This system continued operations until the wastewater treatment facility shut down in 2004.

## **2.3 LNAPL Migration Control**

In the 1970s, a small area located near the northern boundary of the PDA was determined to contain an area of light, non-aqueous phase liquid (LNAPL). The material was determined to be kerosene from an unknown source, but thought to have been introduced to the subsurface from leakage of a historic kerosene holding pond which reportedly existed in this area.

Since the early 1970s several small LNAPL recovery systems have been operated to recover the floating kerosene product from this area. LNAPL recovery, initially automated, is currently mechanically separated from the groundwater in-situ, accumulated in a waste drum on site and when full, disposed off site at the Clean Harbors incineration facility in Deer Park, Texas.

# ***APPENDIX D***



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGION III  
1650 Arch Street  
Philadelphia, Pennsylvania 19103-2029  
June 29, 2010

Mr. Michael House  
Manager, Remedial Projects  
Solutia, Inc.  
575 Maryville Centre Drive  
St. Louis, Missouri 63141

**Reference:** **Approval of the Revised Interim Measures Work Plan dated April 9, 2010.**  
Solutia Inc.: 1 Monsanto Road, Nitro, West Virginia  
EPA ID. No. WVD039990965

Dear Mr. House:

The purpose of this letter is to inform you that EPA and WVDEP have reviewed your responses to the Agencies comments for the November 3, 2009 Draft Interim Measures Work Plan. Based on those responses the Agencies approve the Revised Interim Measures Work Plan dated April 9, 2010.

Please contact me at (215) 814-3184 if you have questions or if I may be of further assistance.

Sincerely,

Bill Wentworth  
Project Manager

c: Tom Bass – WVDEP (w/o enclosure)





Solutia Inc.  
575 Maryville Centre Drive  
St. Louis, Missouri 63141

April 9, 2010

P.O. Box 66760  
St. Louis, Missouri 63166-6760  
Tel 314-674-1000

Mr. Bill Wentworth  
Waste and Chemicals Management Division (3WC23)  
USEPA Region III  
1650 Arch Street  
Philadelphia, PA 19103

Mr. Thomas Bass  
West Virginia Department of Environmental Protection - OER  
Office of Waste Management  
601 57<sup>th</sup> Street, SE  
Charleston, WV 25304-2345 *via Overnight Delivery*

**Reference:** Interim Measures Work Plan  
Solutia Site; 1 Monsanto Road  
Nitro, West Virginia  
EPA ID. No. WVD039990965

Dear Bill and Tom,

Attached you will find responses to comments that were provided to Solutia on February 10, 2010 by the US EPA and the West Virginia DEP in regard to our November 3, 2009 submittal, "Interim Measures Work Plan" for our Nitro, WV site. Also enclosed is the revised work plan which incorporates the changes to address the Agencies' comments. Solutia's responses to comments and revised plan have been prepared in accordance with the direction provided by the US EPA and the West Virginia DEP at our meeting held with the Agencies in Charleston on March 25, 2010. The work plan includes a revised RCRA Corrective Action Schedule. Please note that you will also receive via e-mail a redline version of the work plan for assistance with your review.

Solutia looks forward to beginning the implementation of these measures. If you have any questions regarding this submittal, please call me at (314) 674-6717 or I can be reached via e-mail at [mlhouse1@solutia.com](mailto:mlhouse1@solutia.com).

Sincerely,

A handwritten signature in cursive script that reads "Michael House".

Michael L. House  
Manager, Remedial Projects

**Solutia Inc.**

**Attachments**

**cc: Ron Potesta, Mike Light – Potesta & Associates**

**Interim Measures Work Plan**  
**November 9, 2009**

**Response To Comments**

**JOEL HENNESSY COMMENTS**

1. *The interim measures proposed are final, permanent components of what will ultimately be considered the final remedy for this site. Will an EPA remedy decision-making process with a public comment period be provided?*

**Response:**

If the currently proposed Interim Measures (IMs) or some evolution of these measures are successful in achieving the Corrective Measures Objectives, all elements of the Corrective Action process, including public comment, will be required before the IMs could be accepted as final Corrective Measures. At that time, the current uncertainty will have been removed and the Agencies will have the empirical data to demonstrate the effectiveness of the measures being proposed for selection as Final Corrective Measures. If the Interim Measures Objectives (IMOs) are not being achieved by the measures initially installed, additional measures will be developed at the time when this conclusion is reached.

In addition, the proposed IM approach will provide an opportunity for contemporary public comment. A formal public notice / comment process will be required on modifications to the Site NPDES Stormwater Permit (WV/NPDES Permit No. WV0116181). The public comment process is necessitated by the intrusive activities associated with implementation of the proposed IMs. This procedural step will provide the public with notice of the IM activities planned for the Site and an opportunity to comment. It is West Virginia Department of Environmental Protection's (WVDEP) standard procedure to conduct a public meeting if sufficient interest is expressed by the public on an NPDES permit application.

2. *Table 4-1 and 4-2 indicate that pumping within the containment areas will be conducted to maintain inward gradients. How will these be measured? Will inboard and outboard piezometers be installed around the barrier wall perimeters to demonstrate the inward gradient and to trigger pumping? What will be the performance standard for an inward gradient?*

**Response:**

Inboard and outboard piezometers will be installed to measure the inward gradient and to trigger groundwater pumping. An inward gradient of 6" will be the targeted minimum. A detailed

design package that includes the containment area monitoring system will be presented for the Agencies' approval.

3. ***Table 4-1 and 4-2 indicate that there will be pumping within PDA containment area for LNAPL recovery. Why is LNAPL recovery needed inside the PDA containment area?***

**Response:**

A review of the LNAPL recovery over the past three years reveals that the rate of LNAPL recovery has substantially declined to 10 to 15 gallons per year. Solutia concurs that additional LNAPL recovery post-containment is not necessary.

**IM W/P Modifications:**

Table 4-1 - The referenced statement will be modified as follows:

*"Pumping within the contained area to maintain inward gradient with on-site or off-site groundwater treatment; and ~~pumping of LNAPL within the PDA with off site treatment.~~"*

Table 4-2 - The referenced statement will be modified as follows:

*"Containment of the PDA with a Barrier Wall and Low-Permeability (WV33CSR1 - Subtitle C) Cap. Pumping within contained area to maintain inward gradient ~~and recover LNAPL with on-site or off-site groundwater and LNAPL treatment.~~"*

4. ***Table 4-2 Institutional Controls - The environmental covenant should be acquired after all components of the remedy are constructed and the other remedial components are finalized. The covenant should map out all constructed engineering controls and associated use restrictions for those specific units as well as for site-wide restrictions.***

**Response:**

Agreed.

**IM W/P Modifications:**

The following sentence will be added to Table 4-2, Footnote 1:

*"The environmental covenant will be acquired after all components of the remedy are constructed and all remedial components finalized. The covenant will map out all constructed engineering controls and associated use-restrictions for those specific units and for site-wide restrictions."*

5. ***Table 4-1 proposes a Low Permeability Cover over the Former 2,4,5-T Manufacturing Area, but Table 4-2 indicates it will be a Low Permeability Cap.***

**Response:**

Agreed – “Low-Permeability Cover” is the correct term.

**IM W/P Modifications:**

“Cap” in the following sentence in Table 4-2 will be replaced with “cover”:

*“Low-Permeability ~~Cap~~ Cover over the Former 2,4,5-T Manufacturing Area.”*

6. *Table 4-1: Could the low permeability covers over 2,4,5-T Building demolition debris areas be eliminated (and the number of cover areas minimized) by excavating these smaller specific areas and placing the excavated material within larger containment areas?*

**Response:**

Solutia’s evaluation concludes that excavation and relocation of the 2,4,5-T Building demolition debris areas is neither more cost-effective nor more protective vs. containment with the Low-Permeability Cover in-place.

7. *Table 4-1 and 4-2: The proposed interim measures include containment of the Old Nitro Dump/Waste Pond with a barrier wall and low permeability cap, but Figure 4.2 indicates there are portions of the Old Nitro Dump which will not be within the barrier wall (I64 overlies a portion of the dump). Is the portion of the dump not to be contained a source of Constituents of Concern (COCs) to the River? Will waste material in the Nitro Dump become saturated by rising groundwater levels outside the proposed containment wall as a result of changing groundwater flow (see comment 9, below)?*

**Response:**

The areal extent of the proposed containment of the Old Nitro Dump/Waste Pond with a barrier wall and Low-Permeability Cap encompasses the portion of the Old Nitro Dump that lies outside of the footprint of I-64 Interstate ROW – as well as the Waste Pond. Solutia is not aware of any source of COCs from the portion of the Old Nitro Dump that would continue to lie outside of the contained portion of the Old Nitro Dump.

The elevation of the groundwater flowing east to west in the vicinity of the Old Nitro Dump, discharging into the Kanawha River, is not expected to be significantly affected by installation of the barrier wall around the Old Nitro Dump. The river elevation is maintained at a relatively steady 566’msl (normal pool) and this elevation is expected to exert the controlling influence on the groundwater level – including the portion of the Old Nitro Dump under the footprint of I-64. However, to confirm this expectation, and as discussed in more detail in Response to Comment 9 below, Solutia will be developing a groundwater model for the Site that will assess the effects of the IMs on groundwater level, flow direction, etc.

8. *The specifications for the soil bentonite wall are shown in Table 4-3. What soil will be used to mix with the bentonite? Soil from the trench excavation? In some areas (Old Nitro Dump, for example) the wall is proposed to go through waste material which should not be used in containment wall material. Other areas may encounter old underground utilities or highly contaminated soils. How will these materials be dealt with?*

**Response:**

Following approval of the IM Work Plan (WP), Solutia will submit the following deliverables for Agencies' approval: 1) Barrier Wall Pathway Geotechnical Investigation; and 2) Barrier Wall Pathway Clearing / Slurry Wall Installation Design Package. The general objective of the geotechnical investigation is to procure sufficient information to inform the pathway clearing and slurry wall design and bidding steps that will follow. Some specific information to be obtained by the geotechnical investigation includes:

- Soils conditions - Representative soil samples will be collected for slurry wall vendors' determination of optimum soil-bentonite mixture.
- Depths to bedrock.
- Bedrock core samples will be collected to assess hardness and competency of the bedrock bottom.

Any soils that must be excavated for construction of the slurry wall, but cannot be used in the slurry mix for any reason (contamination or excess), will be placed under the Low-Permeability Subtitle C Caps over the respective containment areas. If clean soils are required for a specific area to obtain slurry wall design specifications, clean fill will be imported from off-site.

9. *Figure 5.1 shows existing and proposed monitoring wells for measuring interim measures effectiveness. The installation of the soil bentonite barrier walls will alter groundwater flow under the site. A flow model should be developed to provide insight on the potential effects of flow changes from wall construction to determine whether the proposed monitoring network locations would be appropriate or if additional monitoring locations will be needed.*

**Response:**

Agreed.

**IM W/P Modifications:**

The following statement will be added to Table 4-2 "Proposed Interim Measures" in the "IM Effectiveness Monitoring" line:

*"A groundwater flow model will be developed to assess the effects of flow changes from barrier wall construction and to determine the need and optimum location for additional groundwater monitoring wells."*

10. *This work plan does not provide many of the details usually provided in a work plan. It appears to be more of a proposal for what the components of interim measures will be. Will task-specific work plans and design documents be submitted? The last sentence in Section 6.1 indicates that detailed design plans for the barrier walls, caps and covers will be submitted for agency review and approval pursuant to the enclosed schedule, but I could not find these specific deliverables listed in the schedule. Will we also get to review work plans for other work, such as the pre-design geological investigation?*

**Response:**

Detailed design plans for the barrier walls, caps and covers will be developed and submitted for Agencies' review / approval. The RCRA deliverable schedule included in Section 6 of the IM WP presents timing for schedule milestones. Detailed schedules with specific itemized deliverables will be developed for Agencies' review / approval for each milestone - following approval of the IM WP.

11. *The work plan should indicate that the proposed barrier wall containment areas are technically impracticable to clean up, and that is the reason for this particular remedy.*

**Response:**

Agreed.

**IM W/P Modifications:**

The following will be added to **Section 4.0 INTERIM MEASURES:**

*"As described in Sections 2 & 3, Solutia has developed a clear understanding of the nature and extent of wastes and affected media on-site. This knowledge, coupled with remedial experience under CERCLA and RCRA programs indicate that removal and disposal and/or onsite treatment of source and waste disposal areas at this Site is impracticable for the following reasons:*

- *The presence of 2,3,7,8-TCDD in Site environmental media and the unavailability of offsite treatment / disposal alternatives within the United States*
- *The areal and vertical extent of affected media*
- *The overall volume of affected soils, waste and groundwater on this 116-acre site*
- *Heterogeneity of wastes in source areas*

*In sites characterized by these types of conditions, Section 300.430(a)(iii)(B) of the NCP establishes that engineering controls, such as containment, coupled with monitoring, institutional controls, etc. are appropriate remedial actions. Therefore, containment-in-place is proposed to control the major Site source areas to prevent the potential for off-site transport of COCs and to mitigate potential exposure pathways. Lesser affected soils and groundwater outside of the major source areas will be monitored and managed-in-place. All Site soils will receive covers to mitigate potential COC exposure pathways and to prevent potential transport of COCs off-site.*

*Installation of the IMs will be followed by implementation of an Interim Measures Effectiveness Monitoring Plan (IM-EMP). The IM-EMP will provide evaluation information to be used to assess the short-term and long-term protectiveness of the IMs and the ability of the IMs to meet Site Corrective Action Objectives."*

- 12. The plan should include a schematic cross section showing the proposed remedy components, i.e., barrier wall construction details, depth, caps, covers, etc.**

**Response:**

Agreed. Detailed design plans for the barrier walls, caps and covers will be developed and submitted for Agencies' review / approval following approval of the IM WP.

**RUTH PRINCE COMMENTS**

**Comment for RPM Bill Wentworth and WV PM Tom Bass**

*The use of interim measures as the presumptive remedy for the Solutia site is problematic from the perspective of interested parties and the public. This is a remedy that will definitely generate public interest and comments, which must be taken into account in the Agencies' decision-making process. Therefore, these interim measures cannot be implemented prior to the opportunity for the public to have input; otherwise it will appear to have been a fait accompli. The obvious solution to this is to require Solutia to revise this "Work Plan" into a presumptive remedy-style CMS.*

**Response:**

See "Response" to Joel Hennessy Comment #1.

**1. General Comment**

*The title of this document is inaccurate. This document is not a work plan, with specifications, design details, schedules, etc. Instead, it is an Interim Measures Conceptual Plan. Please revise the title accordingly, and revise the text and Section 6 schedule to include all actual work plan deliverables to the Agencies for each component of the interim measures.*

**Response:**

The IM WP presents the basis and an overview of work that will be performed at the Site via Interim Measures to address environmental media issues identified during the multiple RCRA investigations. Detailed design plans and specifications for the barrier walls, caps and covers will be developed and submitted for Agencies' review / approval, following Agencies' approval of the proposed IM WP.

The RCRA deliverable schedule included in Section 6 presents milestone events for implementation of the IMs. Detailed schedules for specific deliverables will be developed for Agencies' review / approval for each milestone - following approval of the IM WP.

**2. Section 2.4, Sediments**

***Regardless of the CERCLA Order Kanawha River study being conducted by Monsanto, the Solutia RCRA Facility Investigation Reports include sediment data clearly showing contaminant release to river sediments adjacent to the Solutia facility, at concentrations with potential human health and ecological consequences. This release must be adequately addressed in the interim measures/final remedy for the Solutia facility. Furthermore, since the on-site interim measures/final remedy includes a great deal of capping, this same methodology could be used to contain consolidated aquatic sediment that requires removal from the river environment adjacent to Solutia. Management of this dioxin contaminated sediment will face the same hurdles of managing any dioxin contaminated material, and thus is a good candidate for on-site management and capping.***

**Response:**

Agreements between New Monsanto and Solutia concerning legacy remedial issues associated with the Nitro Site delineate responsibilities between the two companies<sup>1</sup>. With respect to sediments, the delineation is bounded by the Site boundary at the river. New Monsanto is responsible for issues associated with the river, including Kanawha River sediments. With oversight by the USEPA and WVDEP, and pursuant to a CERCLA order<sup>2</sup>, New Monsanto is addressing environmental issues associated with historical releases of 2,3,7,8-TCDD in the Kanawha River, including sediments. Solutia is responsible for the RCRA Site including the river bank down to the water's edge. New Monsanto's October 29, 2009, Draft Engineering Evaluation / Cost Analysis (EE/CA) Report addressing the Kanawha River Site is consistent with this delineation of responsibility. Sediment data collected by Solutia has been provided to Monsanto and incorporated into the EECA Report.

Solutia reiterates its intent to cooperate and coordinate its future actions with the Agencies and New Monsanto – whatever remedies are ultimately approved.

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<sup>1</sup> Mike to provide citation

<sup>2</sup> Administrative Order by Consent (AOC) (CERC-03-2004-0171DC) – “In March 2004, EPA, Monsanto and Pharmacia entered into an Administrative Order on Consent to conduct an Engineering Evaluation and Cost Analysis (EE/CA) on dioxin-contaminated sediment at the Kanawha River Site. The goal of the EE/CA is to characterize the nature and extent of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) contamination in the Kanawha River Site that has been and/or is currently being released from what is now the Flexsys plant. 2,3,7,8-TCDD is the most toxic form of dioxin. The EE/CA will also evaluate removal alternatives, if necessary, that will protect public health, welfare, and the environment.”(USEPA Kanawha River Site website: <http://www.epa.gov/reg3hwmd/npl/WVSEF035516.htm>)

**3. Section 2.5.3, Potential Impact on Aquatic Life**

- a) *The last paragraph of this section refers to “ongoing remediation” of the Kanawha River by New Monsanto. This is inaccurate; to date, there has been no sediment remediation associated with the Monsanto Kanawha River study.*

**Response:**

Understood.

**IM W/P Modifications:**

The referenced sentence will be modified as follows:

*“It is well documented that the water column concentrations will peak during higher flow events with the suspension of river sediments. The load to the water column currently in place due to sediment-associated 2,3,7,8-TCDD is being addressed by performance of an ongoing remediation Engineering Evaluation/Cost Analysis (EE/CA) by New Monsanto. The EECA evaluates removal action alternatives to provide sufficient information for USEPA to determine the necessity, feasibility and efficacy of non-time critical removal actions. Subsequent to Site IMs described herein, overall on-going 2,3,7,8-TCDD loading to the river will be substantially reduced and will minimize additional loading to the sediments.”*

- b) *It is stated in the last paragraph of this section that “Therefore, the potential for harm to aquatic communities is unlikely to be a significant pathway in the Kanawha River . . .”. This is inaccurate based solely on the sediment data collected by Solutia adjacent to the facility, which in many cases exceeds the high risk sediment concentration for fish of 100 ng/kg 2,3,7,8-TCDD TEQs (EPA/600/R-93/055). Kanawha River sediment data collected by Monsanto at other river locations also exceeds the high risk concentration. There has been no sediment remediation to date; therefore, existing sediment conditions most certainly indicate the potential for harm to aquatic communities. Please revise this text accordingly.*

**Response:**

As stated in the Response to Comment 2, New Monsanto is responsible for the river and associated sediments and potential aquatic life issues.

**IM W/P Modifications:**

*As the currently estimated TCDD loadings represent a fraction of that afforded the Site in the TMDL (~14% of “safe loading”), future loadings are considered to be protective of sediments which redeposit after the Kanawha River remediation. ~~Additionally, due to the patchy distribution of sediments and the pelagic nature of fish, the more sensitive aquatic receptor,~~*

~~sediments in the vicinity of the property represent a fraction of the food supply. Therefore, the potential for harm to aquatic communities is unlikely to be a significant pathway in the Kanawha River and protection of the water column for contact recreation should afford the necessary level of protection to the aquatic life.~~

**4. Section 3.1, Area 1 – Source Areas**

***This section must be revised to include a detailed explanation and justification as to why removal of the source material is not a reasonable interim measure and final remedy.***

**Response:**

The following will be added to Section 4.0 INTERIM MEASURES:

**IM W/P Modifications:**

*"As described in Sections 2 & 3, Solutia has developed a clear understanding of the nature and extent of wastes and affected media on-site. This knowledge, coupled with remedial experience under CERCLA and RCRA programs indicate that removal and disposal and/or onsite treatment of source and waste disposal areas at this Site is impracticable for the following reasons:*

- *The presence of 2,3,7,8-TCDD in Site environmental media and the unavailability of offsite treatment / disposal alternatives*
- *The areal and vertical extent of affected media*
- *The overall volume of affected soils, waste and groundwater on this 116 acre site*
- *Heterogeneity of wastes in source areas*

*In sites characterized by these types of conditions, Section 300.430(a)(iii)(B) of the NCP establishes that engineering controls, such as containment, coupled with monitoring, institutional controls, etc. are appropriate remedial actions. Therefore, containment-in-place is proposed to control the major Site source areas to prevent the potential for off-site transport of COCs and to mitigate potential exposure pathways. Lesser affected soils and groundwater outside of the major source areas will be monitored and managed-in-place. All Site soils will receive covers to mitigate potential COC exposure pathways and to prevent potential transport of COCs off-site.*

*Installation of the IMs will be followed by implementation of an Interim Measures Effectiveness Monitoring Plan (IM-EMP). The IM-EMP will provide evaluation information to be used to assess the short-term and long-term protectiveness of the IMs and the ability of the IMs to meet Site Corrective Action Objectives."*

**5. Section 3.2, Area 2 – Former Manufacturing Areas**

***A permanent, permeable soil cover is proposed for Area 2. Please revise this section to reference all data for Area 2 that supports a less protective interim measure/remedy.***

**Response:**

The RFI and Expanded RFI have fully characterized Site soils and groundwater within Area 2<sup>3</sup>, which are areas within the Process Area that are not source areas, based on investigative results and are not disposal areas. The ERFI<sup>4</sup> contains the comprehensive body of investigative data results for Area 2 soils and Site groundwater. ERFI Section 5.1.1 defined the Corrective Measure Objectives (CMOs) for Area 2 as, "... protect the river from stormwater transport of 2,3,7,8-TCDD and from groundwater transport of COCs... in support of the WVAWQC for 2,3,7,8-TCDD concentration in the river of  $\leq 0.014$  pg/l". These same CMOs have been adopted as Interim Measures Objectives (IMOs) as well.

The IM approach to achieve the IMO is to cut off the potential pathway for soil erosion by preventing stormwater contact with the soils. The proposed IM for Area 2-Former Manufacturing Areas, is a permanent, permeable cover. The cover consists of a geotextile marker layer and an 18-inch vegetative soil layer. This proposal is essentially a BMP for stormwater. The cover will be designed with low slope factors for prevention of erosion from stormwater. In combination with proposed covenants restricting land use to commercial/industrial<sup>5</sup>, and the proposed IM Effectiveness Monitoring Plan requiring periodic monitoring of Site surface water, the proposed IMs will be fully protective of Human Health and the Environment and are expected to meet the IMO.

**6. Section 4.1, Interim Measures Objectives (IMOs)**

***This section states that the IMOs are premised on the Site remaining industrial or commercial. Please revise to provide an analysis of future site conditions based on the USEPA OSWER Directive 9355.7-04 Land Use in the CERCLA Remedy Selection Process, specifically providing the bulleted list of information on p. 5 of this directive.***

**Response:**

The primary objective of OSWER Directive 9355.7-04 is to, "...promote early discussions with local land use planning authorities, local officials, and the public regarding reasonably anticipated future uses of the property...". Achievement of this objective has been the subject of an on-going effort by multiple stakeholders associated with the Nitro Site. In an effort to integrate specific reuse scenarios and to facilitate redevelopment of the Site, Solutia began working with area and state redevelopment authorities in early 2007, including the Charleston Area Alliance; the WV Development Office; the Marshall University Brownfields Office; the

<sup>3</sup> "Area 2 – Former Manufacturing Areas" was designated as "Area 1 – Protect the River Areas", in the ERFI, dated February 17, 2007.

<sup>4</sup> February 16, 2007 Draft Expanded RCRA Facility Investigation, as approved by an April 25, 2008 letter from William Wentworth, Remedial Project Manager, USEPA to Mr. Michael L. House, Solutia Inc.

<sup>5</sup> Interim Measures Work Plan, Table 4-2, "Proposed Interim Measures".

Putnam County Development Office; and the West Virginia Port Authority. Many of the meetings and discussions have included involvement of the WVDEP. These efforts are continuing with periodic meetings and progress updates.

To date, there is general agreement among all stakeholders associated with the Site that a residential use in the future is inappropriate; and that a commercial / industrial reuse that maintains the protectiveness of the remedies in place at the time are both appropriate and desired. Implementation of the IM WP elements will not preclude most commercial/industrial reuse scenarios.

The information suggested by the bulleted checklist on page 5 of OSWER Directive 9355.7-04 is either not applicable to the Site or is readily available if a specific redevelopment opportunity arises.

### **IM W/P Modifications**

The first paragraph in Section 4.1 Interim Measures Objectives will be revised to read as follows:

*“USEPA OSWER Directive 9355.7-04 Land Use in the CERCLA Remedy Selection Process encourages early discussions of Site stakeholders with local and area land use planning authorities, local officials, and the public regarding reasonably anticipated future uses of the property. Solutia began working with area and state redevelopment authorities in early 2007, including the Charleston Area Alliance; the W.V Development Office; the Marshall University Brownfields Office; the Putnam County Development Office; and the West Virginia Port Authority.*

*There is agreement among all Site stakeholders that a residential use in the foreseeable future is inappropriate; and that a commercial / industrial use that maintains the protectiveness of the remedies in place at the time are both appropriate and desired. Implementation of the IM W/P will not preclude commercial/industrial reuse scenarios currently being reviewed.*

*Therefore, Interim Measure Objectives (IMOs) have been developed for Site soils, riverbank, wastes and groundwater. The IMOs are premised on the Site remaining industrial or commercial.*

**7. Sections 4.1.3, Area 3 (Non-Manufacturing) and 4.1.4, Area 4 (Riverbank) and Table 4-1, IMOs**

*Both sections and Table 4-1 state that the Area 3 and 4 IMO is to “Prevent exposures of Site users and/or trespassers to soils and debris.” Please revise to reference all of the data indicating that soil and debris exposures in these areas must be controlled, and evaluate the protectiveness of the proposed controls.*

### **Response:**

Based on Site investigations and stormwater management experience, it has been shown that the potential exists for offsite transport of TCDD via the stormwater pathway. Therefore, the entire

Site will receive covers to prevent potential transport of COCs off-site. This will also control potential COC exposure pathways to affected Site soils.

**8. Section 4.1.5, Site-Wide Groundwater**

*Since barrier walls are to be installed to eliminate discharge of groundwater contaminants to the Kanawha River, this should be added to this section as a short-term IMO. Please revise accordingly.*

**Response:**

Agreed.

**IM W/P Modifications:**

Solutia proposes to modify the list of short-term IMOs for Nitro Site Groundwater as follows:

*Short-term IMOs for the Nitro site groundwater include:*

- *Eliminate the potential for groundwater transport of COCs from major site source areas. Monitor concentrations of 2,3,7,8-TCDD and PCE and its breakdown products in groundwater to confirm improvement over time and:*
- *Control site groundwater use.*

**9. Section 4.1.6, Aquatic Sediments and Table 4-1, IMOs**

*Refer to the comments above for Sections 2.4 and 2.5.3, and revise accordingly.*

**Response:**

Please refer to Comment 2 Response.

**10. Tables 4-1 through 4-3**

- a) *Low permeability covers are proposed for the Former 2,4,5-T Manufacturing Area, the WTA Impoundments, and the WTA 2,4,5-T Building Demolition Disposal Area in Table 4-3. The primary difference between the low permeability cover and the Subtitle C Low Permeability Cap proposed for some of the source areas is that the cover lacks the cap drainage layer which ensures long-term stability in response to changing precipitation/groundwater flow regimes. Furthermore, the cover on the A3 Basin has already been super saturated and subsequently breached by a high precipitation period. Therefore, only Subtitle C caps will be considered adequate for all source areas to satisfy interim measure/final remedy requirements. Please revise accordingly.*
- b) *Please add the following justification to Section 4.1.5 (Site-Wide Groundwater): reference and describe all groundwater data that supports the use of barrier walls for only the PDA, Process Area TCE Source Area, and the Old Nitro*

***Dump/Waste Pond. Explain why barrier walls are unnecessary for the other identified source areas.***

- c) ***Caps and covers are proposed for particular "areas." However, cap boundaries must actually be defined by soil cleanup goals. This plan must be revised to include soil cleanup goals for all relevant soil contaminants. In relation to this issue, USEPA has just released a Public Review Draft (OSWER 9200.3-56) entitled Draft Recommended Interim Preliminary Remediation Goals for Dioxin in Soil at CERCLA and RCRA Sites (December 30, 2009). The recommended interim PRGs are 72 ng/kg 2,3,7,8-TCDD TEQs for residential soils, and 950 ng/kg 2,3,7,8-TCDD TEQs for industrial soils. These PRGs must be taken into account in the development of the dioxin soil clean-up goal for the Solutia site. However, this Solutia-specific dioxin clean-up goal must also be protective of uncontrolled storm-driven sheet flow from the site to the Kanawha River.***

**Response:**

Please see combined Response for 10a, 10b and 10c below.

Three major COC source areas have been defined at the Site by historical knowledge and investigative results (i.e. PA PCE Source Area; PDA; and the Old Nitro Dump). These source areas are characterized by the highest concentrations of COCs at the Site in groundwater and soils and are therefore proposed to be fully contained by barrier walls keyed into bedrock in combination with caps (i.e. Subtitle C Caps).

The differentiation in the proposed caps & cover types and the areal extent of each type are driven by the variation in the need to control infiltration of stormwater. The Low-permeability Caps and barrier walls are proposed to be used for Site source areas for total containment and optimum prevention of infiltration to groundwater. Low-Permeability Covers, without containment of the groundwater, are proposed for areas of lower COC concentration in both soils and groundwater based on historical knowledge and Site investigations (i.e. Former 2,4,5-T Mfg. Area and WTA Former Impoundments). Groundwater outside of the fully contained areas will be monitored over time to insure that adequate progress is being made over time toward achievement of the sitewide groundwater IMOs identified in Table 4-1. Permanent Permeable Covers will be placed over all other areas of Site not covered by Subtitle C Caps or Low-Permeability Covers.

Site characterization has shown that the highest quantities of 2,3,7,8-TCDD transport from the Site to the Kanawha River are associated with surface water rather than groundwater. All three cap & cover types proposed for the Site will prevent the potential transport of 2,3,7,8-TCDD and other COCs via surface water. Each of the cover types will also prevent the potential for a completed contact exposure pathway between the affected (or potentially affected) soils and potential receptors (i.e. achieve the intermediate / long-term IMOs for soils and stormwater identified in Table 4-1).

Implementation of the IM-EMP will provide confirmation of the continuing effectiveness of the caps, covers and groundwater containment by requiring periodic inspection and maintenance to assure conformance to original performance specifications. The IM-EMP will also provide information to assess progress toward achievement of all intermediate/long-term IMO's identified in Table 4-1.

Future land use will be restricted to commercial/industrial via restrictive covenants<sup>6</sup>. Any future commercial industrial use scenario will undergo its own review and approval process by the Agencies.

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<sup>6</sup> This is an environmental covenant executed pursuant to the Voluntary Remediation and Redevelopment Act, West Virginia Code Chapter 22, Article 22, and the Uniform Environmental Covenants Act, West Virginia Code Chapter 22, Article 22B



**FINAL  
INTERIM MEASURES  
WORK PLAN**

***Solutia Inc. Nitro Site  
Nitro, West Virginia***

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Project No. 0101-01-0081-700A

April 9, 2010



## TABLE OF CONTENTS

1.0	PROJECT OVERVIEW .....	1
1.1	Site Description.....	1
1.2	Historical Site Use .....	2

Figure 1.1 - Site Location Map

2.0	SUMMARY OF SITE CONDITIONS .....	4
2.1	TCDD Migration.....	4
2.1.1	Groundwater Pathway.....	4
2.1.2	Surface Water Pathway.....	5
2.2	Source Area Migration.....	5
2.3	Nitro Facility Sewer System .....	6
2.4	Sediments.....	7
2.5	Conclusions.....	7
2.5.1	TCDD.....	7
2.5.2	PCE .....	7
2.5.3	Potential Impact on Aquatic Life.....	7

Figure 2.0 - COC Migration to Kanawha River via Surface Water & Groundwater & Pathways

3.0	CONCEPTUAL SITE MODEL .....	9
3.1	Area 1 - Source Areas .....	9
3.2	Area 2 - Former Manufacturing Areas.....	10
3.3	Area 3 – Non Manufacturing Areas.....	10
3.4	Area 4 - River Bank .....	10

Figure 3.1 - Process Area - Interim Measures WP Conceptual Site Model

Figure 3.2 - Wastewater Treatment Area - Interim Measures WP Conceptual Site Model

4.0	INTERIM MEASURES.....	11
4.1.	Interim Measures Objectives .....	11
4.1.1	Area 1 (Source Areas).....	12
4.1.2	Area 2 (Former Manufacturing).....	13
4.1.3	Area 3 (Non-Manufacturing) .....	13
4.1.4	Area 4 (Riverbank) .....	13
4.1.5	Site-wide Groundwater .....	14
4.1.6	Aquatic Sediments .....	14

Table 4-1 - Interim Measures Objectives

4.2	Proposed Interim Measures.....	15
4.2.1	Projected Effectiveness of Proposed Interim Measures.....	15
4.3	Potential Integration of Contiguous Property .....	16
Table 4-2 - Proposed Interim Measures		
Table 4-3 - Interim Measures Technical Specifications		
Figure 4.1 - Process Area Interim Measures		
Figure 4.2 - Wastewater Treatment Area Interim Measures		
5.0	INTERIM MEASURES EFFECTIVENESS MONITORING PLAN .....	17
5.1	Objectives .....	17
5.2	Sampling and Inspections .....	17
5.3	Reporting.....	18
Table 5-1 - Interim Measures Effectiveness Monitoring Plan Summary		
Figure 5.1 - Interim Measures Effectiveness Monitoring Wells		
6.0	INTERIM MEASURES WORK PLAN SUMMARY / SCHEDULE .....	19
6.1	Scope of Work .....	19
6.2	Schedule.....	20
6.3	Reporting.....	20
RCRA Deliverable Schedule		
7.0	CLOSING .....	21
<b>APPENDIX A</b>		
Pre-Interim Measures TCDD Flux to River		
Post-Interim Measures TCDD Flux to River		
2008 Supplemental Data Collection – 2Q08 Dioxin Results – Round 1		
2008 Supplemental Data Collection – 3Q08 Dioxin Results – Round 2		

## ACRONYMS AND DEFINITIONS

COCs	Constituents of Concern (i.e., constituent concentrations in Site media are greater than an established health based screening levels for that respective media)
CSM	Conceptual Site Model
DCE	Dichloroethylene
ERFI	Expanded RCRA Facility Investigation conducted in 2Q05 – 3Q06
IM	Interim Measures
IM-EMP	Interim Measures Effectiveness Monitoring Plan
IMO	Interim Measure Objective
Old Monsanto	The Monsanto Company founded in 1901
New Monsanto	The Monsanto Company first incorporated as a subsidiary of Pharmacia in 2000 and then spun off as a separate company in 2002
PA	“Process Area” within the Solutia Nitro Site
PCE	Tetrachloroethylene or “Perc”
PDA	“Past Disposal Area” within the Solutia Nitro Site
Permit	Solutia Nitro Site RCRA Corrective Action Permit (I.D. WV039990965)
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
Source Area	The Former Rubber Chemicals Manufacturing Area within the PA with high concentrations of PCE, TCE, DCE and VC in groundwater
TCDD	2,3,7,8 tetrachlorodibenzo-para-dioxin
TCE	Trichloroethylene
TEQ	TCDD Toxicity Equivalent Quotient
Solutia	Solutia Inc.
SWMU	Solid Waste Management Unit
TMDL	TCDD Total Maximum Daily Load (for TCDD)
USEPA	United States Environmental Protection Agency
VC	Vinyl chloride
WTA	Solutia Nitro Site former Wastewater Treatment Area
WVABCA	West Virginia Alcoholic Beverage Control Administration
WVAWQC	West Virginia Ambient Water Quality Criteria
WVDEP	West Virginia Department of Environmental Protection, Office of Land Reclamation

## INTERIM MEASURES WORK PLAN

### *Solutia Inc. Nitro Site Nitro, West Virginia*

#### 1.0 PROJECT OVERVIEW

This Interim Measure (IM) Work Plan (WP) has been prepared pursuant to the Site Resource Conservation and Recovery Act (RCRA) Corrective Action Permit, I.D. WV039990965 (Permit), Section E.2, "Interim Measures." This WP presents a basis for a recommended Scope of Work (SOW) to be completed as IMs for the Solutia Nitro, West Virginia facility (Site) soils and groundwater. The proposed IMs will be completed as part of the continuing RCRA Corrective Action program at the Site. The IMs are designed to be compatible with future site redevelopment options and anticipated final RCRA Corrective Measures. The purpose of this WP is to present an overview of the current Site conditions and to provide details related to the proposed IMs for Site environmental media.

An IM Effectiveness Monitoring Plan has been developed to be initiated following implementation of the SOW. The purpose of the monitoring plan is to assess the effectiveness of the IMs toward achievement of the objectives for Site environmental media. This monitoring plan is discussed in Section 5.0.

#### 1.1 Site Description

Solutia's Site, formerly known as Flexsys America L.P. (Flexsys) Nitro, West Virginia, is located along the eastern (right-descending) bank of the Great Kanawha River (Kanawha River), approximately one-half mile north of the City of Nitro in Putnam County, West Virginia (Figure 1.1). The Site is a former chemical manufacturing plant, which began production of various chemical compounds in the early 1910s and continued until mid-2004. From mid-2004 through December 2005, all operating facilities were shut down, decommissioned and dismantled to grade.

The Site encompasses approximately 122 acres and is divided into two separate areas by Interstate 64: 1) a southern area encompassing approximately 76 acres, which was the former Process Area (PA) and; 2) a northern area, encompassing approximately 46 acres, which was the former Wastewater Treatment Area (WTA) and included the wastewater treatment plant and wastewater impoundments.

Characterization Information on soils, groundwater, sediments and surface water obtained during performance of RCRA Facility at the Site has been used to divide the Site into the following four areas to facilitate development of the Conceptual Site Model.

- Area 1 - Source Areas;
- Area 2 - Former Manufacturing Areas;
- Area 3 - Non-Manufacturing Areas (Parking, Administration, Warehousing and Undeveloped Land, and;
- Area 4 - Riverbank.

These areas are further described later in Section 3.0 Conceptual Site Model.

## 1.2 Historical Site Use

Chemical production began at the Site in 1918 when the United States Government started producing smokeless powder (nitrocellulose) for use in World War I. Nitrocellulose production ended in 1921 when the Site was purchased by the Rubber Services Company and used for the manufacturing of chloride, phosphate and phenol compounds. Monsanto Company (Old Monsanto) purchased the facility in 1929 from Rubber Services Company and added the manufacture of flotation agents, pickling inhibitors, anti-oxidants, anti-skinning, wetting agents, and oils to the existing production operations in the 1930s.

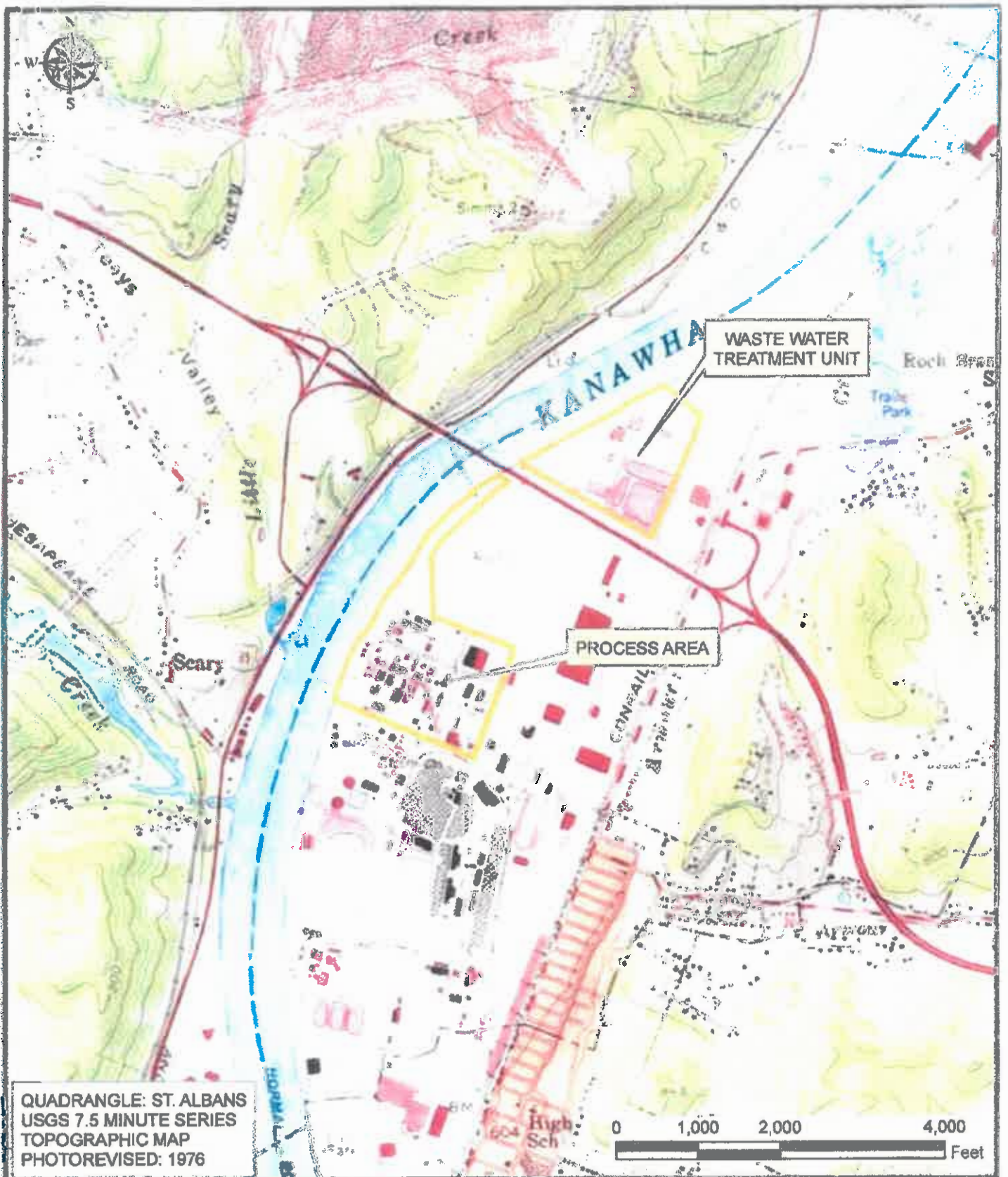
Old Monsanto continued to expand operations at the Site and accelerated its growth in the 1940s, including the production of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) and sodium trichlorophenoxyacetic acid. A byproduct of the production of 2,4,5-T is the creation of 2,3,7,8 tetrachlorodibenzo-para-dioxin (TCDD). TCDD has been detected in surface soils at the Nitro Site. Production of the herbicide 2,4,5-T was initiated at pilot scale during the summer of 1948; plant scale production began in October 1948 in Building 34. As the demand for the herbicide increased during the Vietnam War, a new integrated facility in Building 92 was constructed and came online in August 1963. Production of the herbicide continued until demand for the product eased and production ceased at the Site in 1969. Several of the units associated with the production of the herbicide were decontaminated, demolished and buried on site during the early 1970s.

The manufacturing of rubber chemicals initially comprised about 65 percent of the Site's operations. The product line was diversified with new additions over the years, including the aforementioned herbicide production and an animal feed nutritional additive in addition to rubber chemicals including vulcanization accelerators, vulcanization inhibitors and anti-oxidants for miscellaneous rubber products. A variety of raw materials were used in the multiple chemical production processes carried out at the Site over the years, including inorganic compounds, organic solvents, and other organic compounds.

All production operations, maintenance and facility management of the Nitro plant were transferred to Flexsys in 1995. This transfer agreement included the entire Site and substantially all of the assets except the improved real estate and certain limited manufacturing assets. The RCRA Permit was modified (Class I modification) to reflect the change in permittee status from Old Monsanto to both Old Monsanto and Flexsys. In 1997, Old Monsanto spun off its chemical businesses to a newly created company called Solutia Inc. (Solutia). The equity acquired by

Solutia included Old Monsanto's interest in Flexsys, including the Nitro facility, as well as Old Monsanto's solely owned assets and liabilities at the Nitro Site. Assets included the real Site property while liabilities included responsibility for RCRA Corrective Action. In 2000, Old Monsanto entered into a merger and changed its name to Pharmacia Corporation (Pharmacia). Also in 2000, New Monsanto, based on the previous agricultural division of Pharmacia was incorporated as a standalone subsidiary of Pharmacia. In 2002, New Monsanto was spun from Pharmacia as a separate company. Pharmacia became a subsidiary of Pfizer in 2003.

In October 2003 Flexsys made a business decision to cease all chemical production at the Nitro facility. Activities began during the second quarter of 2004 to dismantle, decontaminate, and remove all surface structures including the wastewater treatment plant facility. Demolition was completed in December 2005.



SCALE: AS NOTED  
DATE: NOVEMBER 2009  
PROJECT NO.: 01-0081-330  
DRAWN: RWR

Title

Site Location Map  
Groundwater Protection Plan  
Solutia Nitro Site

## 2.0 SUMMARY OF SITE CONDITIONS

Past site investigations, performed for the RCRA Facility Investigation (RFI) at the Site are summarized in the February 16, 2007, Expanded RFI (ERFI) Report. One conclusion of these investigations is that TCDD is migrating from the Former 2,4,5-T Manufacturing Area, the Past Disposal Area (PDA) and the Closed Wastewater Impoundments via the groundwater and/or surface water pathways and discharging to the Kanawha River (see Figure 2.0 for locations of areas and groundwater wells). Another conclusion is that tetrachloroethene (also known as perchloroethene or PCE) or its breakdown products (trichloroethylene or TCE; dichloroethene or DCE; and vinyl chloride or VC) are migrating from the Former Rubber Chemicals Manufacturing Area (Source Area) via the groundwater pathway and discharging to the Kanawha River. Migration of these constituents via the groundwater and/or surface water pathway is discussed below.

### 2.1 TCDD Migration

#### 2.1.1 Groundwater Pathway

TCDD migration to the Kanawha River via the groundwater pathway was evaluated by collecting high-volume groundwater samples during April, May, June and July of 2008. Groundwater samples were collected from seven existing TCDD migration well pairs and two existing plume stability well pairs located in the PA; and four existing TCDD migration well pairs and two new TCDD migration well pairs installed in the WTA (Figure 2.0). Average concentration data from these monitoring wells were used to determine the TCDD Toxicity Equivalent Quotient (TEQ) flux from the PA (including the PDA) and the WTA to the Kanawha River via the groundwater pathway as shown below:

#### AVERAGE TCDD (as TEQ) Migration to River via the Groundwater Pathway (2008 / 3Q08 database)

<u>TCDD Source Area and Migration Pathway</u>	<u>Groundwater Discharge to Surface Water (GPD)</u>	<u>Average Dioxin TEQ Concentration in Groundwater (pg/L)</u>	<u>Dioxin TEQ Flux to Kanawha River via Groundwater Pathway (ug/day)</u>
<b>Shallow Groundwater</b>			
• Process Area	36	0.067	0.0000
• Past Disposal Area	206	0.153	0.0001
• Wastewater Treatment Area	328	0.654	0.0008
<b>Deep Groundwater</b>			
• Process Area	7,017	0.008	0.0002
• Past Disposal Area	2,447	0.037	0.0003
• Wastewater Treatment Area	9,049	0.195	0.0067
<b>Total Average Dioxin TEQ Flux to the Kanawha River via the Groundwater Pathway</b>			<b>0.0082 ug/day</b>

Based on this evaluation, the average TCDD flux (as TEQ) from the Site to the Kanawha River via the groundwater pathway is 0.05 percent of the 16.5 ug/day “safe loading level” for TCDD as defined in the TCDD Total Maximum Daily Load (TMDL) Report<sup>1</sup> for the Kanawha River.

### 2.1.2 Surface Water Pathway

As required by Site NPDES Permit No. WV0116181, Solutia currently collects quarterly stormwater samples from Outfall 001, which is located in the PA and Outfall 003 located in the WTA. Monthly stormwater samples are collected from Outfall 002, also located in the WTA (Figure 2.0). Stormwater sampling data, collected from the three outfalls in 2007, were used to determine TCDD flux from the Site to the Kanawha River via the surface water pathway:

#### TCDD Migration to the Kanawha River via the Surface Water Pathway in 2007

<u>TCDD Source Area and Migration Pathway</u>	<u>Average Stormwater Discharge to Surface Water (GPD)</u>	<u>Maximum TCDD Concentration in Stormwater (pg/L)</u>	<u>Maximum TCDD Flux to Kanawha River via Surface Water Pathway (ug/day)</u>
<b>Process Area</b>			
• Outfall 001	137,000	2.3	1.203
<b>Wastewater Treatment Area</b>			
• Outfall 002	3,000	18.5	0.200
• Outfall 003	15,000	2.3	0.134
• Sheet Flow	13,000	18.5	<u>0.908</u>
<b>Total TCDD Flux to the Kanawha River via the Surface Water Pathway</b>			<b>2.445 ug/day</b>

This analysis demonstrates that the maximum TCDD flux from the Site to the Kanawha River via the surface water pathway is 14.9 percent of the 16.5 ug/day “safe loading level” for TCDD.

### 2.2 Source Area Migration

A Source Area was detected in the Former Rubber Chemicals Manufacturing Area within the PA (“Source Area”) during the CA-750 Groundwater Environmental Indicator Site investigation conducted in 2003 (See Figure 2.0). The source consisted primarily of tetrachloroethene (also known as perchloroethylene or PCE) or its breakdown products (TCE, DCE and VC). Maximum detected PCE, TCE, DCE and VC concentrations in the Source Area were 12,000 ug/L; 14,000 ug/L; 56,000 ug/L and 17,000 ug/L, respectively, in 2Q03 and 3Q03. Chlorobenzene (12,000 ug/L), ethylbenzene (12,000 ug/L) and xylene (36,000 ug/L) (maximum concentrations) were also detected in this Source Area.

<sup>1</sup> “Dioxin TMDL Development for Kanawha River, Pocatalico River and Armour Creek, West Virginia”, dated September 14, 2000, prepared for U.S EPA Region III by Tetra-Tech, Inc. (see Page 42)

A plume stability evaluation performed for the ERFI from 2Q05 to 3Q06 confirmed the presence of a chloroethene Source Area in the Former Rubber Chemicals Manufacturing Area. However, PCE was no longer present and maximum detected concentrations of TCE, DCE and VC were 3,800 ug/L, 73,000 ug/L and 15,000 ug/L, respectively. Chlorobenzene, ethylbenzene and xylene were still present in this Source Area at maximum concentrations of 11,000 ug/L, 720 ug/L and 670 ug/L, respectively.

Quarterly Plume Stability Monitoring has continued at the Site since the ERFI sampling was completed in 3Q06. In 2Q09, TCE, DCE and VC maximum concentration in the Source Area was 1,400 ug/L, 61,000 ug/L and 7,100 ug/L, respectively. These PCE breakdown products were also present in downgradient monitoring wells adjacent to the Kanawha River at maximum detected concentrations of 1,900 (GW-4A/B); 27,000 ug/L (GW-9 A/B) and 3000 ug/L (GW-11 A/B), respectively (Figure 2.0). Chlorobenzene, ethylbenzene and xylene were also present in the Source Area at maximum detected concentrations of 1,600 ug/L, 160 ug/L and 51 ug/L, respectively. However, in downgradient monitoring wells, chlorobenzene and xylene were detected at a maximum concentration of 350 ug/L (MW-10 A/B) and 6.6 ug/L (MW-0 A/B) respectively while ethylbenzene was not detected.

Surface water sampling performed for the 2003 CA-750 Groundwater Environmental Indicator Site investigation demonstrated that groundwater discharges from the PA did not result in an exceedance of West Virginia Ambient Groundwater Quality Criteria (WVAWQC) in the Kanawha River.

### **2.3 Nitro Facility Sewer System**

Solutia, Flexsys and the Agencies (Parties) reached an agreement in 1995 on how the Facility Sewer System Solid Waste Management Unit (SWMU) would be addressed. The agreement among the Parties was based on the following documents:

- "Facility Sewer System Stabilization Work Plan," Roux Associates, Inc. August 5, 1994.
- "Sewer Stabilization Measures Evaluation Report," Roux Associates, Inc., May 30, 1995. This report presented a comparative analysis of conceptual sewer stabilization measures alternatives.
- "Detailed Sewer Stabilization Measures Plan, Roux Associates, Inc.," November 27, 1996.

The agreement among the Parties was that Flexsys would fund an estimated \$25 Million Stabilization Measure to install above grade process sewers, eliminating the use of the below grade Facility Sewer System for process wastewater streams, in lieu of further characterization and investigation of the Facility Sewer System SWMU. Installation of this Stabilization Measure pursuant to the November 27, 1996 Work Plan was nearing completion when the decision was made by Flexsys in October 2003 to discontinue operations at its Nitro facility.

As stated earlier, the decision in October 2003 to discontinue operations at the Nitro facility was followed by decontamination and dismantling of all surface structures to grade in 2004-2005. Any potential for the Nitro Facility Sewer System to intercept the groundwater and to provide a direct pathway to the river was eliminated as an element of the 2004-2005 Site demolition. During the facilities demolition phase, the Nitro Facility Sewer System was physically blocked with concrete at each drop inlet and manhole (~125 locations) throughout the Site. In addition, each Nitro Facility Sewer System outfall at the river was also physically blocked with concrete.

## **2.4 Sediments**

Pursuant to an agreement between New Monsanto and Solutia, responsibility for the historical Kanawha River sediments and any required actions related to these sediments to protect Human Health or the Environment will be the responsibility of New Monsanto. Pursuant to a United States Environmental Protection Agency (USEPA) CERCLA order<sup>2</sup>, New Monsanto is currently conducting studies on a section of the Kanawha River which includes the area adjacent to the Site. Kanawha River sediments are among the issues subject to that investigation.

## **2.5 Conclusions**

### **2.5.1 TCDD**

TCDD is migrating to the Kanawha River from the Former 2,4,5-T Manufacturing Area, the PDA and the Closed Wastewater Impoundments via the groundwater and surface water pathways. Although TCDD flux is less than 15 percent of the "safe loading level" (16.5 ug/day), migration from these source areas should be controlled because the WVAWQC for 2,3,7,8-TCDD in the Kanawha River is 0.014 pg/L, a very low number established to protect human health.

### **2.5.2 PCE**

PCE breakdown products (TCE, DCE and VC) are migrating from the Former Rubber Chemicals Manufacturing Area and discharging to the Kanawha River via the groundwater pathway. Even though TCE concentrations in the Kanawha River downgradient of the Former Rubber Chemicals Manufacturing Area are below the 81 ug/L WVAWQC, migration from this source area should be controlled to ensure that this criterion will continue to be achieved.

### **2.5.3 Potential Impact on Aquatic Life**

While West Virginia has no specific aquatic life numeric criteria for TCDD, the Kanawha River is protected by the application of a warm water aquatic life use designation and the protection offered by the applicable narrative criteria. In addition to meeting the applicable contact

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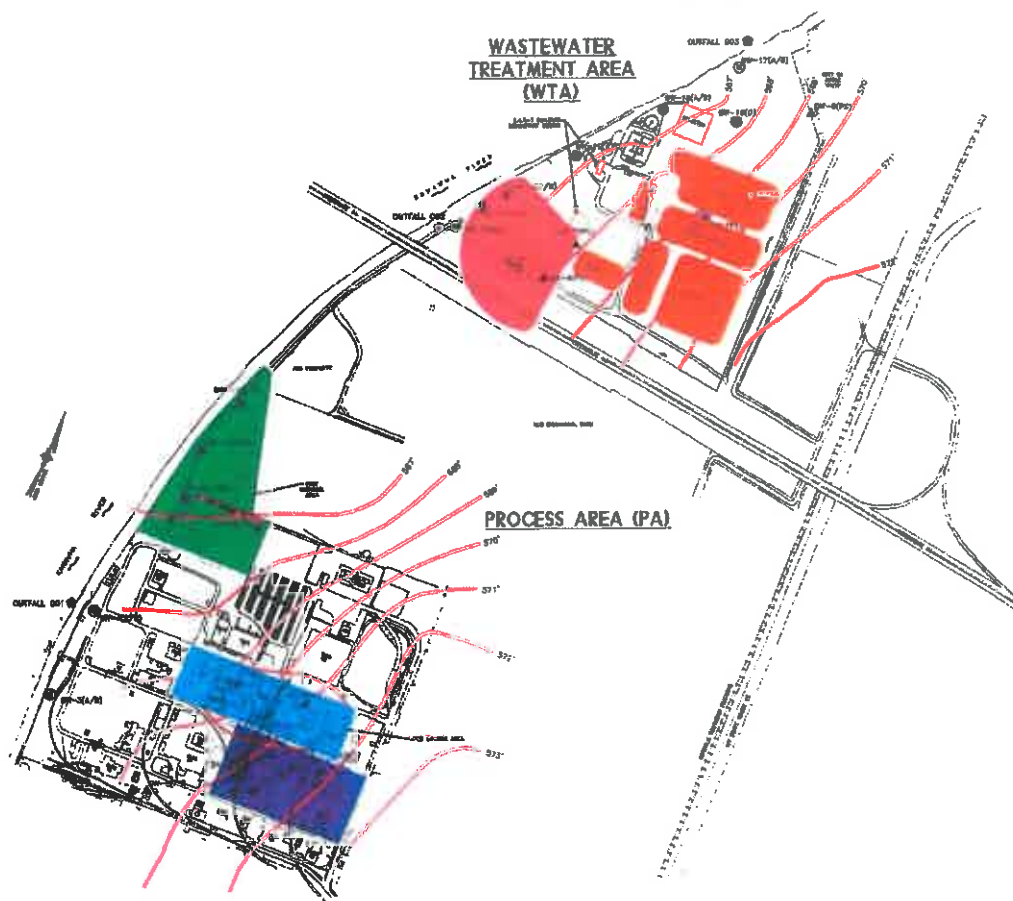
<sup>2</sup> Administrative Order by Consent for Removal Action, EPA Docket No. CERC-03-2004-0171DC, Kanawha River Site, West Virginia

recreation criteria in the area adjacent to and downstream of the properties, the TCDD concentrations in the river must be conducive to the establishment of aquatic communities.

TCDD concentrations which can be expected to affect aquatic life have been evaluated in several studies summarized by the USEPA in 1993. This interim report on assessment of environmental risks (EPA/600/R-93-055) suggests that amphibians and invertebrates are much less sensitive to TCDD than fish, and that a water column concentration of 0.6 pg/l (conservative value based on particulate organic carbon concentration) would equate to a low risk of harm to aquatic life. As this number is well above the state's drinking water and contact recreation criteria, attainment of the water column standards should adequately protect aquatic life.

It is well documented that the water column concentrations will peak during higher flow events with the suspension of river sediments. The load to the water column currently in place due to sediment-associated TCDD is being addressed by performance of an Engineering Evaluation/Cost Analysis (EE/CA) by New Monsanto. The EECA evaluates removal action alternatives to provide sufficient information for USEPA to determine the necessity, feasibility and efficacy of non-time critical removal actions. Subsequent to Site IMs described herein, overall on-going TCDD loading to the river will be substantially reduced and will minimize additional loading to the sediments. As the currently estimated TCDD loadings represent a fraction of that afforded the Site in the TMDL (~14% of "safe loading"), future loadings are considered to be protective of sediments which redeposit after the Kanawha River remediation.

WASTEWATER  
TREATMENT AREA  
(WTA)



● TOWN (TOD) MOUNTAIN WELL CLUSTER  
 010-170 - SHALLOW ZONE  
 010-170 - DEEP ZONE  
 ● PLUMB SENSITIVITY / TOWN MOUNTAIN DAM, ONE WELL CLUSTER  
 ● CURRENT OUTLAGE  
 ▲ PLUMB SENSITIVITY WELL CLUSTER  
 010-0 (P) A - SHALLOW ZONE  
 010-0 (P) B - DEEP ZONE  
 \*\*\*SUNSHINE 575' SINKHOLE/INLET ELEVATION

 FAST RESPONSE AREA  
 CLOSED WATERWAY IMPROVEMENTS  
 OLD RHYTH UNIT

 FORMER RUBBER CHEMICAL MANUFACTURING AREA  
 POE SOURCE AREA  
 FORMER 3,4,5-T MANUFACTURING AREA

GRAPHIC SCALE

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED  
DATE 08-11-2010 BY 60322 UCBAW/SJS/STP

**Potomac & Associates, Inc.**

# POTESTÀ

**SOLUTION NITRO SITE  
NITRO, WEST VIRGINIA**

**COC MIGRATION TO  
KANAWHA RIVER  
VIA SURFACE WATER &  
GROUNDWATER PATHWAYS**

### 3.0 CONCEPTUAL SITE MODEL

Existing information on source areas, soils, groundwater, sediments and surface water, obtained during performance of RCRA Facility Investigations and Interim Measures at the Site was used to develop the Conceptual Site Model (CSM) described in this section. This CSM divides the Site into four areas: Area 1 - Source Areas; Area 2 - Former Manufacturing Areas; Area 3 - Non-Manufacturing Areas (Parking, Administration, Warehousing and Undeveloped Land); and Area 4 - Riverbank (Figure 3-1).

#### 3.1 Area 1 - Source Areas

Area 1 consists of two former manufacturing areas (the Former 2,4,5-T Manufacturing Area and the Former Rubber Chemicals Manufacturing Area); three waste disposal areas (PDA, Old Nitro Dump and Former 2,4,5-T Production Building Demolition Debris Disposal Area); and six closed surface impoundments in the WTA (Waste Pond, Limestone Bed, Surge Basin, Equalization Basin, Emergency Basin, and A3 Basin). The Former 2,4,5-T Manufacturing Area, the Former Rubber Chemicals Manufacturing Area and the PDA are located in the PA. The Old Nitro Dump, Former 2,4,5-T Production Building Demolition Debris Disposal Area and the closed surface impoundments are located in the WTA. Figures 3-1 and 3-2 show the areal extent of Area 1 along with the location of the individual source areas.

**Process Area** – Previous IMs performed in the Former 2,4,5-T Manufacturing Area (gravel, asphalt and concrete covers) and the PDA (soil and gravel cover) have improved conditions such that it is currently protective of Site users. However, because TCDD and other COCs are present in these Source areas, additional protectiveness could be attained by replacement of these temporary covers with more durable, low-permeability cover as an additional IM. Such an engineered cover would ensure long-term prevention of human exposure to source area soils and wastes and long-term control of TCDD migration from these source areas to the Kanawha River via the surface water pathway.

Installation of a low-permeability cap and barrier wall around the PDA would physically contain impacted soils and wastes and prevent migration of TCDD from this source area to the adjacent Kanawha River via the groundwater pathway.

Impacted groundwater is migrating from the PCE source in Area 1 and discharging to the Kanawha River. Migration of PCE and its breakdown products (TCE, DCE and VC) from this source area could be controlled by installing a low-permeability cap and barrier wall at the Former Rubber Chemicals Manufacturing Area.

**Wastewater Treatment Area** – Previous IM soil covers on the two closed waste disposal areas and the six closed impoundments in the WTA are currently protective of Site users. However, long-term permanent protection of Site users could be achieved by installation of additional IMs composed of low-permeability covers over these closed impoundments and waste disposal areas.

In June 2003 a seep was observed coming from the A3 Basin. The seep was hypothesized to have originated from unusually heavy rainfall beginning in May and June 2003 in the southern WV area, causing the 1-foot soil cover over the stabilized sludge in the A3 Basin to become saturated. As the water in the saturated soil cover traveled toward the lowest elevation point in the Basin cover, the soil became supersaturated and the seep broke out on the ground surface. The interim measure consisted of placement of a 40 mil. HDPE synthetic rain covers over the entire A3 Basin area over an additional soil cover of approximately 2 feet over the lowest point in the Basin to maintain a slope of 1% minimum. The seep has not re-occurred and water levels below the basin have dropped significantly.

### **3.2 Area 2 - Former Manufacturing Areas**

Area 2 is comprised of the former manufacturing areas in the PA that are not included in the Former 2,4,5-T Manufacturing Area and the Former Rubber Chemicals Manufacturing Area (Figures 3.1 and 3-2). Stormwater discharging from Area 2 to the Kanawha River does not exceed the Site's NPDES Permit limits because an earlier IM, utilizing flow control, gravel and vegetated covers, gravel berms and silt fences along with existing concrete building slabs, asphalt parking lots and roadways, has effectively isolated surface water runoff contact with underlying soils. Long-term protection of public health and the environment could be achieved in Area 2 by installation of an additional IM composed of a permanent, permeable soil cover to provide a more robust protection from human contact with surface soils and limit entrainment of TCDD in stormwater runoff discharging to the Kanawha River.

### **3.3 Area 3 – Non Manufacturing Areas**

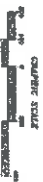
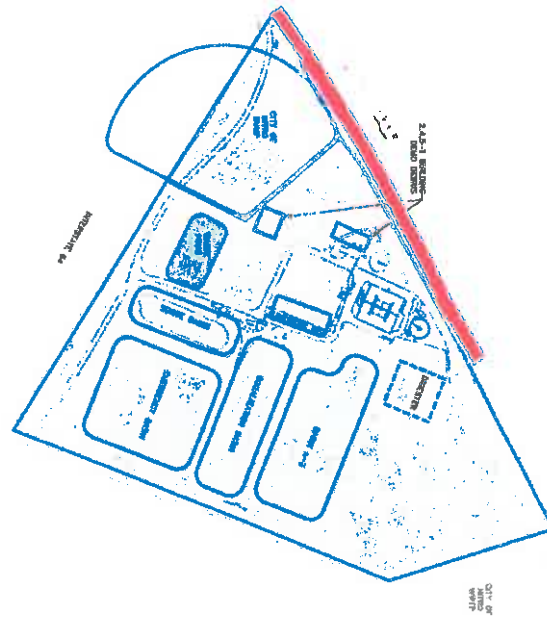
Area 3 consists of land in the PA and WTA that was used for parking, administration, warehousing or left undeveloped (Figures 3.1 and 3.2). Soils in the PA and WTA are currently protective of human health except for TCDD concentrations at the P-07 surficial soil sampling location in the PA and the W-25 soil sampling location in the WTA<sup>3</sup>. Risks associated with these soil sampling locations could be controlled by additional Interim Measures consisting of consolidation of these soils within the PDA followed with installation of a permanent, permeable soil cover. As discussed above, the PDA can be contained by a barrier wall and a low-permeability cap.

### **3.4 Area 4 - River Bank**

Area 4 is the exposed bank of the Kanawha River along the entire PA and the southern portion of the WTA (Figures 3.1 and 3.2). In 2003, an Interim Measure was performed on the river bank adjacent to the PDA to remove residue seepage material and stabilize the slope by installing geotextile and rip-rap armor. Additional improvements in the stability of the river bank could be attained by installation of an additional IM consisting of clearing and grading of the bank, followed by placement of geotextile and rip-rap armoring along the entire exposed river bank in the PA and the WTA.

<sup>3</sup> "Expanded RCRA Facility Investigation Report", dated February 16, 2007 Potesta and Associates, Inc.





Scale: 1" = 100' (1:1200)  
 Date: 10/10/00  
 Drawn by: J. L. Smith  
 Checked by: J. L. Smith  
 Approved by: J. L. Smith

- LEGEND**
- AREA 1 - SOURCE AREA
  - AREA 2 - FUTURE WASTEWATER TREATMENT AREA
  - AREA 3 - NON-MANUFACTURING AREAS
  - AREA 4 - INTERIOR

#### 4.0 INTERIM MEASURES

As described in Sections 2 & 3, Solutia has developed a clear understanding of the nature and extent of wastes and affected media on-site. This knowledge, coupled with remedial experience under CERCLA and RCRA programs indicate that removal and disposal and/or onsite treatment of source and waste disposal areas at this Site is impracticable for the following reasons:

- The presence of 2,3,7,8-TCDD in Site environmental media and the unavailability of offsite treatment / disposal alternatives within the United States.
- The areal and vertical extent of affected media.
- The overall volume of affected soils, waste and groundwater on this 116-acre site.
- Heterogeneity of wastes in source areas.

In sites characterized by these types of conditions, Section 300.430(a)(iii)(B) of the NCP establishes that engineering controls, such as containment, coupled with monitoring, institutional controls, etc. are appropriate remedial actions. Therefore, containment-in-place is proposed to control the major Site source areas to prevent the potential for off-site transport of COCs and to mitigate potential exposure pathways. Lesser affected soils and groundwater outside of the major source areas will be monitored and managed-in-place. All Site soils will receive covers to mitigate potential COC exposure pathways and to prevent potential transport of COCs off-site.

Installation of the IMs will be followed by implementation of an Interim Measures Effectiveness Monitoring Plan (IM-EMP). The IM-EMP will provide evaluation information to be used to assess the short-term and long-term protectiveness of the IMs and the ability of the IMs to meet Site Corrective Action Objectives.

##### 4.1. Interim Measures Objectives

USEPA OSWER Directive 9355.7-04 “**Land Use in the CERCLA Remedy Selection Process,**” encourages early discussions of Site stakeholders with local and area land use planning authorities, local officials, and the public regarding reasonably anticipated future uses of the property. Solutia began working with area and state redevelopment authorities in early 2007, including the Charleston Area Alliance; the West Virginia Development Office; the Marshall University Brownfields Office; the Putnam County Development Office; and the West Virginia Port Authority.

There is agreement among all Site stakeholders that a residential use in the foreseeable future is inappropriate; and that a commercial/industrial reuse that maintains the protectiveness of the remedies in place at the time is both appropriate and desired. Implementation of the IM WP will not preclude commercial/industrial reuse scenarios currently being reviewed.

Therefore, Interim Measure Objectives (IMOs) have been developed for Site soils, riverbank, wastes and groundwater. The IMOs are premised on the Site remaining industrial or commercial.

The CSM presented in Section 3 of this work plan divides the Site into four areas, which are summarized below and shown on Figures 3.1 and 3.2:

#### Area 1 – Source Areas

##### Process Area

- Former 2,4,5,-T Manufacturing Area
- Former Rubber Chemicals Manufacturing Area
- Past Disposal Area

##### Wastewater Treatment Area

- Old Nitro Dump
- Former 2,4,5-T Production Building Demolition Debris Disposal Area
- Closed Surface Impoundments
  - Waste Pond
  - Limestone Bed
  - Surge Basin
  - Emergency Basin
  - Equalization Basin
  - A3 Basin

#### Area 2 – Former Manufacturing Areas

Those portions of the PA, formerly used for chemical manufacturing, that are not known source areas or disposal areas.

#### Area 3 – Non Manufacturing Areas

Land in the PA and WTA that was used for parking, administration (offices) and warehousing or left undeveloped.

#### Area 4 - River Bank

Area 4 is the exposed bank of the Kanawha River along the entire PA and the southern portion of the WTA. “Exposed bank” is defined as the bank face extending from the top-of-bank to normal pool on the river (566’) across the site as depicted on Figures 3.1 and 3.2.

The IMO’s described in the following sections are developed specific to environmental media within each Site Area.

##### **4.1.1 Area 1 (Source Areas)**

Area 1 (Source Areas) IMO’s, which are presented below, are designed to control the potential for human exposure to wastes and impacted soil and groundwater in the source areas, and;

migration of TCDD and PCE (and its breakdown products) from the source areas to the Kanawha River via the groundwater and/or surface water pathways.

- Prevent exposure of current and future Site users and/or trespassers to wastes, soils and groundwater in Area 1;
- Control migration of TCDD from Area 1 to the Kanawha River such that the groundwater and surface water discharges do not exceed the “safe loading level” for the Site; and
- Control migration of PCE and its breakdown products from Area 1 to the Kanawha River such that the groundwater discharge does not cause an exceedance of WVAWQC in the river.

#### **4.1.2 Area 2 (Former Manufacturing)**

Area 2 IMO address migration of TCDD to the Kanawha River via the surface water pathway, i.e., protect the river. IMOs for Area 2 include:

- Prevent exposure of current and future Site users and/or trespassers to Area 2 soils and groundwater; and
- Control migration of TCDD from Area 2 to the Kanawha River such that the surface water discharges do not exceed the “safe loading level” for the Site.

#### **4.1.3 Area 3 (Non-Manufacturing)**

Area 3 is either undeveloped property or has been used primarily for parking, administration or warehousing. The IMO for Area 3 is:

- Prevent exposures of Site users and/or trespassers to soils and debris.

#### **4.1.4 Area 4 (Riverbank)**

Area 4 is the exposed bank of the Kanawha River along the entire PA and the southern portion of the WTA. The IMO for Area 4 is:

- Prevent exposures of Site users and/or trespassers to soils and debris.

#### 4.1.5 Site-wide Groundwater

USEPA's groundwater protection and clean-up strategy for RCRA Corrective Action is to address the greatest risks first and to make meaningful progress toward the ultimate goal of returning groundwater to its maximum beneficial use. USEPA also expects final remedies to control or eliminate surface and subsurface sources of groundwater contamination. The proposed IMs to control Site sources to groundwater will make progress consistent with USEPA strategy.

Short-term IMOs for the Nitro site groundwater include:

- Eliminate the potential for groundwater transport of COCs from major site source areas. Monitor concentrations of TCDD and PCE and its breakdown products in groundwater to confirm improvement over time; and
- Control site groundwater use.

The West Virginia Groundwater Protection Act [WV Code § 22-12-4(b)] states that achievement of groundwater cleanup criteria will require reasonable efforts to mitigate further releases of contaminants from SWMUs, impoundments and affected soils, using the site boundary as the point of compliance, and reduction of contaminant levels, as practicable, over time. Therefore, the long-term IMO for Site-wide groundwater is achievement of State and Federal Cleanup criteria.

#### 4.1.6 Aquatic Sediments

As described in section 2.4 **Sediments**, New Monsanto is currently conducting studies on a section of the Kanawha River which includes the area adjacent to the Site. One outcome of these studies will be a determination if a clean-up action is required to address the historical sediments along the Site river boundary - along with other Kanawha River sediments. The following Solutia IMOs will apply to aquatic sediments in the area adjacent to the Site following any clean-up actions by New Monsanto to address the historical sediments.

IMOs for aquatic sediments are summarized as follows:

- Control migration of TCDD from Area 1 to the Kanawha River such that the groundwater and surface water discharges do not exceed the "safe loading level"<sup>4</sup> for the Site, and;
- Control migration of PCE and its breakdown products from Area 1 to the Kanawha River such that the groundwater discharge does not cause an exceedance of the WVAWQC in the river.

IMOs for all Site environmental media are summarized in Table 4-1.

<sup>4</sup> 16.5 ug/day TCDD to the Kanawha River as defined in the 2001 TCDD Total Maximum Daily Load Report for the Kanawha River.

TABLE 4-1

Interim Measures Objectives  
Solutia Inc. - Nitro, WV Site

AREA	Environmental Media	Interim Measures Objectives		Recommended Interim Measures
		Short-Term	Intermediate / Long-Term	
Area 1 - Source Areas	Soil/Wastes	1) Implement Site Health and Safety Plan and Site security procedures to prevent exposure of industrial and construction workers and trespassers to source area soils and wastes prior to and during the construction of Interim Measures.	1) Prevent exposures of current and future Site users and trespassers to soils and wastes	(1) Low Permeability Covers over the Former 2,4,5-T Manufacturing Area; Former WTA Closed Lagoons (Emergency Basin, Surge Basin, Equalization Basin, A-3 Basin, Limestone Bed); and 2,4,5-T Building Demolition Debris Disposal Area in the WTA.
	Groundwater	2) Control Site sources and monitor TCDD, PCE, TCE, DCE and VC concentrations in groundwater to confirm improvement over time following Interim Measures implementation. 3) Control Site groundwater use until long-term CMOs are achieved.	2) Control migration of TCDD to the Kanawha River via the groundwater pathway such that the sum from all Site sources is below the "safe loading level" <sup>(1)</sup> for the Site. 3) Control migration of PCE and its breakdown products to the Kanawha River via the groundwater pathway to a level that is protective of surface water quality.	(2) Containment of PDA; the TCE Source area within the former Rubber Chemicals Manufacturing Area within the PA; and the Old Nitro Dump / Waste Pond within the WTA; Containment to consist of Barrier Walls and Low Permeability Caps (compliant with WV33CSR1-Subtitle C) over the PDA; Pumping within the contained area to maintain inward gradient with on-site or off-site groundwater treatment; and pumping of LNAPL within the PDA with off-site treatment.
	Stormwater	4) Maintain compliance with the NPDES Permit <sup>(1)</sup>	4) Control migration of TCDD to the Kanawha River via the stormwater pathway such that the sum from all Site sources is below the "safe loading level" <sup>(2)</sup> for the Site.	(3) Institutional controls restricting site uses to non-residential and prohibiting groundwater extraction for all reasons except monitoring. (4) Monitor COC mass flux to the river.
Area 2 - Former Manufacturing Areas	Stormwater	5) Maintain compliance with the NPDES Permit <sup>(1)</sup>	5) Prevent exposures of Site users and trespassers to soils. 6) Control migration of TCDD to the Kanawha River via the stormwater pathway such that the sum of all Site sources is below the "safe loading level" <sup>(2)</sup> for the Site.	(5) Permanent, permeable covers - All areas of the Site without Low Permeability Caps (compliant with WV33CSR1-Subtitle C) or Low Permeability Covers will receive permanent, permeable covers. (6) Monitor COC mass flux to the river.
Area 3 - Non-Manufacturing Areas	Soils	6) Implement Site Health and Safety Plan and Site security procedures to prevent exposure of industrial and construction workers and trespassers to Area 3 soils prior to and during the construction of Interim Measures.	7) Prevent exposures of current and future Site users and trespassers to soils.	7) Same as Interim Measures No. 5 and No. 6 above.
Area 4 - Riverbank	Soils	7) Implement Site Health and Safety Plan and Site security procedures to prevent exposure of industrial and construction workers and trespassers to Area 4 soils prior to and during the construction of Interim Measures.	8) Prevent exposures of current and future Site users and trespassers to soils	8) Riprap Armoring of the entire river bank in the former Process Area and over approximately the southern 2/3 rds of the former WTA river bank.
Riverbank - Along Site boundary	Aquatic Sediments adjacent to the Site (post-New Mountain clean-up)	8) Prevent COC re-entrainment and transport off-site by Site stormwater	9) Protect aquatic sediments adjacent to the Site by reduction in COC transport via improvements in groundwater and surface water quality pursuant to IMO's 2, 3 and 4 above.	9) IMs 1 thru 9 above
Sitewide Groundwater	Groundwater	9) Monitor groundwater downgradient of the Former Rubber Chemicals Manufacturing Area and the Wastewater Treatment Area	10) Determine if the Interim Measures are capable of achieving State and Federal groundwater cleanup criteria <sup>(3)</sup> or what additional actions are required for final RCRA Corrective Measures	(10) Additional Monitoring wells and Long-Term Monitoring - Annual PCE, TCE, DCE and VC monitoring in three well pairs downgradient of the Former 2,4,5-T Manufacturing Area and the Former Rubber Chemicals Manufacturing Area (GW-4 and 5 and newly constructed well pair adjacent to NE corner of closed Firewater Lagoons). Annual TCDD TEQ monitoring in two well pairs downgradient of the WTA Impoundments (GW-18 and 19)

<sup>(1)</sup> It is anticipated that an NPDES permit will not be required following Interim Measures implementation.

<sup>(2)</sup> "Safe Load Level" for the Site established in the TMDL Report: "Dioxin TMDL Development for Kanawha River, Pocahontas River and Armour Creek, West Virginia", dated September 14, 2000, prepared for U.S. EPA Region III by Tetra-Tech, Inc.

<sup>(3)</sup> Achievement of groundwater cleanup criteria will require reasonable efforts to eliminate or mitigate further releases of contaminants from SWMUs, impoundments and affected soils and reduction of contaminant levels, as practicable, over time, to support reasonably expected use. These criteria may include the implementation of institutional and/or engineering controls.

**Area 1 - Source Areas:** Former 2,4,5-T Manufacturing Area, Former Rubber Chemicals Manufacturing Area and Past Disposal Area in the Process Area and the Old Nitro Dump; 2,4,5-T Demolition Debris Area, Waste Pond, Limestone Bed, Surge Basin, Emergency Basin, Equalization Basin and A-3 Basin in the Wastewater Treatment Area  
**Area 2 - "Former Manufacturing Areas":** areas in the PA and WTA - never used directly for manufacturing or disposal - where the IMO is to protect the river from stormwater transport of TCDD and from groundwater transport of COCs.  
**Area 3 - "Potentially Clean Land"** areas of the PA and WTA which have never been associated with manufacturing or disposal activities.  
**Area 4 - Riverbank:** The riverbank adjacent to the PA and the southern 2/3rds of the WTA.  
*Form: Corrective Measures Table (Rev. 10/10/2008) (Rev. 9/1/2010)*

## 4.2 Proposed Interim Measures

The Site RFI<sup>5</sup> and ERFI<sup>6</sup>, conducted in 1995 and 2006 respectively, have resulted in development of a thorough Site characterization and CSM. The technologies selected as proposed Interim Measures (IMs) have been successfully demonstrated in multiple past remedial actions, and have been shown to be effective engineered and management systems for controlling the migration of Site COCs in soils and groundwater. Installation of the proposed remedies as IMs will provide timely, full-scale demonstrations that the selected technologies will achieve the site specific clean-up objectives. The IM approach is consistent with the Site RCRA Permit<sup>7</sup> and the Advanced Notice of Proposed Rulemaking (ANPR) on "Action for Releases for Solid Waste Management Units at Hazardous Waste Management Facilities", published May 1, 1996, in The Federal Register, Vol. 61, No. 85, pp 19431-19464. Both ANPR and the Site RCRA Permit state that an IM approach may be utilized if warranted by site-specific conditions.

The proposed IMs for all Site areas and environmental media are presented in Table 4-2, "Proposed Interim Measures." Technical specifications for each of the IMs are presented in Table 4-3, "Interim Measures Technical Specifications." Figures 4.1 and 4.2 visually display on Site maps the types and locations for all proposed IMs.

### 4.2.1 Projected Effectiveness of Proposed Interim Measures

It is estimated that implementation of the proposed IMs will reduce the TCDD loading to the river from Site groundwater by 94% from the current low levels, resulting in an average TCDD concentration in Site groundwater discharging to the river of 0.006 pg/L, well below the TMDL target of 0.014 pg/l for the Kanawha River (see Appendix A). The proposed IMs address virtually all Site soils. These caps and covers are projected to reduce the TCDD flux to the River in surface water by 100%. Therefore, the total effect of the proposed IMs is a 99.98% overall reduction in TCDD flux to the River (i.e. from 2.445 ug/day for surface water and 0.00732 ug/day for groundwater to zero for surface water and 0.00043 ug/day for groundwater). Reductions in TCDD flux to the river will be evaluated pursuant to the Interim Measures Effectiveness Monitoring Plan discussed in Section 5.0.

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<sup>5</sup> "RCRA Facility Investigation and Stabilization/ Measure Plan", dated May 5, 1995, and the Addendum, dated August 7, 1995, both by Roux Associates, Inc. The August 7, 1995 Addendum responded to the Agencies' June 16, 1995 Comments on the May 5, RFI Report.

<sup>6</sup> "Expanded RCRA Facility Investigation Report", dated February 16, 2007, Potesta & Associates, Inc., with attachment of USEPA and WVDEP "Draft Comments for the February 16, 2007 Draft Expanded RFI Report", dated August 24, 2007, as approved by letter to Michael House, Solutia Inc. dated April 25, 2008, William Wentworth, USEPA Remedial Project Manager.

<sup>7</sup> RCRA Corrective Action Permit, EPA ID WVD039990965, Part II-Specific Facility Conditions, E. Interim Measures

### 4.3 Potential Integration of Contiguous Property

Figure 4.1 shows the approximately 2.8-acre Western Parcel of the approximately 12-acre West Virginia Alcoholic Beverage Control Administration (WVABCA) warehousing and distribution facility, which is contiguous to the PDA. The same IM that is proposed for the PDA is a potential IM for this property<sup>8</sup>. Multiple investigations of the Western Parcel indicate that the IM proposed for the PDA would also be protective for the WVABCA Western Parcel. Accordingly, the installation of the barrier wall and cap planned for the PDA could be extended to the Western Parcel and be performed as one integrated project with the PDA IM. In such case, the final location of the barrier wall along the eastern boundary of the Western Parcel as depicted on Figure 4-1 would be determined prior to installation.

Inclusion of the Western Parcel into the PDA IM project would require agreement between New Monsanto and WVABCA on the Western Parcel remediation (i.e. final design; access for investigation and remediation; future access; etc.). If this agreement is not reached in a timely manner (i.e. consistent with the enclosed RCRA Deliverable Schedule for the Solutia Site located in Section 6.0), installation of the PDA IM will proceed independent of the WVABCA Western Parcel remediation.

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<sup>8</sup> See Table 4-2 for the PDA IM description and Table 4-3 for detailed IM technical specifications.

TABLE 4-2

## Proposed Interim Measures

Type	Media	Site Area	Interim Measures
Institutional Controls	Groundwater/ Soils	Site-Wide	Land use restricted to commercial / Industrial via restrictive covenant <sup>1</sup>
			Prohibition of Groundwater extraction via restrictive covenant for any reason other than monitoring and /or treating
Source Control	Soils and Groundwater	Process Area	Containment of the PCE Source Area within the Former Rubber Chemicals Manufacturing Area with a Barrier Wall and Low-Permeability Cap (WV33CSR1 -Subtitle C). Pumping within contained area to maintain inward gradients with on-site or off-site groundwater treatment
			Low-Permeability Cover over the Former 2,4,5-T Manufacturing area
			Permanent Permeable Cover over remainder of Process Area
		Past Disposal Area	Containment of the PDA with a Barrier Wall and Low-Permeability (WV33CSR1 -Subtitle C) Cap. Pumping within contained area to maintain inward gradient
		Riverbank	Rip-Rap armoring of the exposed PA (~2500 LF) and WTA river bank (southern ~1600 LF).
		Wastewater Treatment Area	Containment of the Old Nitro Dump/Waste Pond with a barrier wall and Low-Permeability Cap (WV33CSR1 - Subtitle C); Pumping within contained area to maintain inward gradients with on-site or off-site groundwater treatment
			Low-Permeability Cover over 2,4,5-T Building demolition debris; Limestone Bed, Surge Basin, Emergency Basin, Equalization Basin and A3 Basin.
		Site-Wide	A groundwater flow model will be developed to assess the effects of flow changes from barrier wall construction and to determine the need and optimum location for additional groundwater monitoring wells.
			Semi-annual sampling of IM effectiveness monitoring wells for Site COCs.
			Semi-annual Dioxin TEQ sampling of IM Effectiveness Monitoring wells along the Site river boundary.
IM Effectiveness Monitoring	Groundwater	Site-Wide	Annual sampling of Site surface water and Kanawha River for Site COCs

<sup>1</sup> This is an environmental covenant executed pursuant to the Voluntary Remediation and Redevelopment Act, West Virginia Code Chapter 22, Article 22, and the Uniform Environmental Covenants Act, West Virginia Code Chapter 22, Article 22B. The environmental covenant will be acquired after all components of the remedy are constructed and all remedial components finalized. The covenant will map out all constructed engineering controls and associated use-restrictions for those specific units and for site-wide restrictions

Table 4-3

## Interim Measures Technical Specifications

IM Type	Applicable Site Area(s)	Specifications
<b>Low Permeability Cap</b>		
	<b>PDA</b>	<i>Compliant with WV 33CSR1 (Subtitle C)</i>
	PA TCE Source Area	° 18" (avg.) bedding layer
	Old Nitro Dump / Waste Pond	° Geotextile Cushion
		° 40 mil HDPE
		° Composite Drainage Layer
		° Piping over Drainage Layer
		° 18" Vegetative Soil Layer
<b>Low Permeability Cover</b>		
	PA Former 2,4,5-T Manuf. Area	° 8" soil bedding layer
	<u>WTA Impoundments</u>	° 40 mil HDPE
	- Emergency Basin	° Geotextile
	- Surge Basin	° 18" Vegetative Soil Layer
	- Equalization Basin	
	- A3 Basin	
	- Limestone Bed	
	<u>WTA</u> - 2,4,5-T building demolition debris disposal area	
<b>Permanent, Permeable Cover</b>		
	All areas of the Site without Low Permeability Caps or Low Permeability Covers	° Geotextile
		° 18" Vegetative Soil Layer
<b>Barrier Wall</b>		
	<b>PDA</b>	Soil / bentonite (~2 %) Slurry Wall
	PA TCE Source Area	$1 \times 10^{-7}$ cm/sec permeability
	Old Nitro Dump / Waste Pond	Width ~ 2-3 ft.
		Depth ~ 55-60 ft. to impervious strata
		Keyed ~ 3 ft into underlying impervious strata
<b>River Bank Armoring w/ Rock Riprap</b>		
	PA Riverbank (~ 2500 LF)	Commercially Purchased Limestone
	Southern WTA Riverbank (~ 1600 LF)	Hard, durable limestone w/ d50 of 12"
		Rock size range of 6" min. to ≤ 18" max. with ≤ 6% by weight < 6"
		≤ 30% weight loss when subjected to 5 cycles of Sodium Sulfate Soundness Test - ASTM C88-99a <u>Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate</u> as modified by the American Association of State Transportation Officials (AASHTO) T-104



CAPS & COVERS

- GROUNDWATER

CONTINUOUS PROPERTY

WALLS, RICHARD L. 1930-2000, 217/10  
WALLS, RICHARD L. 1930-2000, 217/10  
WALLS, RICHARD L. 1930-2000, 217/10

[illegible]

REPORT OF PROGRESS  
 RESEARCH IN PROGRESS BY THE BOARD OF DIRECTORS  
 OF THE BOARD OF DIRECTORS OF THE BOARD OF DIRECTORS

**CAPS & COVERS**

STIMULANT - ACTUALLY, CRYSTAL

LOW PERMEABILITY COVER

PROTEOLAKK ABONDIPIK

## GROUNDWATER

СРОЧНАЯ? ИЛИ ДОЛГАЯ?

## **5.0 INTERIM MEASURES EFFECTIVENESS MONITORING PLAN**

### **5.1 Objectives**

The Interim Measures Effectiveness Monitoring Plan (IM-EMP) is a multi-year monitoring and evaluations plan to be initiated upon completing the installation of all IMs. The overall purpose of the IM-EMP can be defined in three timeframes:

1. Confirm that the IMs are initially functioning consistent with the design specifications.
2. In the intermediate timeframe, provide sufficient data to evaluate the rate of improvement of Site environmental media relative to the media objectives (see Table 4-1).
3. Longer term, provide data which can be used to assess the adequacy of the IMs toward achievement and maintenance of the long-term Site media objectives and long-term, permanent protection of Human Health & the Environment.

The long-term objective of the IM-EMP will be to determine if additional measures will be required to achieve State and Federal groundwater cleanup criteria.

### **5.2 Sampling and Inspections**

The IM-EMP will consist of the following periodic activities with the analytical results to be reported on an annual basis:

- Annual inspection of all Caps and Covers
- Annual assessment of all Institutional Controls for completeness and Site compliance
- \* Semi-annual sampling of all groundwater IM-EMP Monitoring Wells
  - a) Analysis for Site COCs
  - b) Calculation of COC mass flux to the river
- \* Semi-annual sampling of the Kanawha River surface water for Site COCs
  - a) Comparison of water column COC concentrations to WVAWQC where available; comparison with other criteria where appropriate
- o Annual Site surface water sampling and analysis for Site COCs

Table 5-1 presents a summary of the IM-EMP as they relate to Site IMOs.

Figure 5.1 displays a map of the Site IMs illustrated and IM-EMP Monitoring Well locations.

### 5.3 Reporting

Beginning with the first full year following completion of the installation of all IMs, annual IM-EMP reports will begin. The annual IM-EMP report will summarize the sampling and inspection results from the previous year and assess progress toward achievement of IMOs. The annual IM-EMP report will be submitted in the first quarter of each year for the prior year report period.

TABLE S-1

Interim Measures Effectiveness Monitoring Plan Summary  
Soluda Inc. - Nitro, WV Site

AREA	Environmental Media	Interim Measures Objectives (IMOs)		Interim Measures Effectiveness Monitoring Plan
		Short-Term	Intermediate / Long-Term	
Area 1 - Source Areas	Soil/wastes	1) Implement Site Health and Safety Plan and Site security procedures to prevent exposure of industrial and construction workers and trespassers to source area soils and wastes prior to and during the construction of Interim Measures.	1) Prevent exposures of current and future Site users and trespassers to soils and wastes	1) Annual inspection of all caps & covers; 2) Annual assessment of all Institutional Controls for completeness and Site compliance
	Groundwater	2) Control Site sources and monitor TCDD, PCE, TCE, DCE and VC concentrations in groundwater to confirm improvement over time following Interim Measures implementation. 3) Control Site groundwater use until long-term CMOs are achieved.	2) Control migration of TCDD to the Kanawha River via the groundwater pathway such that the sum from all Site sources is below the "safe loading level" <sup>(2)</sup> for the Site. 3) Control migration of PCE and its breakdown products to the Kanawha River via the groundwater pathway to a level that is protective of surface water quality.	3) Annual groundwater sampling of all IM Effectiveness Monitoring Wells <sup>(3)</sup> / analysis for Site COCs / calculation of COC mass flux to river; 4) Annually sampling of Kanawha River surface water for Site COCs <sup>(4)</sup>
	Stormwater	4) Maintain compliance with the NPDES Permit <sup>(1)</sup>	4) Control migration of TCDD to the Kanawha River via the stormwater pathway such that the sum from all Site sources is below the "safe loading level" <sup>(2)</sup> for the Site.	5) Annual Site surface water sampling and analysis for Site COCs;
Area 2 - Former Manufacturing Areas	Stormwater	5) Maintain compliance with the NPDES Permit <sup>(1)</sup>	5) Prevent exposures of Site users and trespassers to soils. 5.a) Control migration of TCDD to the Kanawha River via the stormwater pathway such that the sum of all Site sources is below the "safe loading level" <sup>(2)</sup> for the Site.	
Area 3 - Non-Manufacturing Areas	Soils	6) Implement Site Health and Safety Plan and Site security procedures to prevent exposure of industrial and construction workers and trespassers to Area 3 soils prior to and during the construction of Interim Measures.	6) Prevent exposures of current and future Site users and trespassers to soils.	See Item 1 above.
Area 4 - Riverbank	Soils	7) Implement Site Health and Safety Plan and Site security procedures to prevent exposure of industrial and construction workers and trespassers to Area 4 soils prior to and during the construction of Interim Measures.	7) Prevent exposures of current and future Site users and trespassers to soils	See Item 1 above.
Sitewide Groundwater	Groundwater	8) Monitor groundwater downgradient of the Former Rubber Chemicals Manufacturing Area and the Wastewater Treatment Area	9) Determine if the Interim Measures are capable of achieving State and Federal groundwater cleanup criteria <sup>(5)</sup> , and; 10) If not, what additional actions are required for final RCRA Corrective Measures	See Item 3 above.
Reporting				6) Comprehensive Effectiveness Monitoring Report summarizing monitoring results and assessing progress toward achievement of IMOs – due annually in 1Q for preceding year.

<sup>(1)</sup> It is anticipated that an NPDES permit will not be required following Interim Measures implementation and a demonstration period.

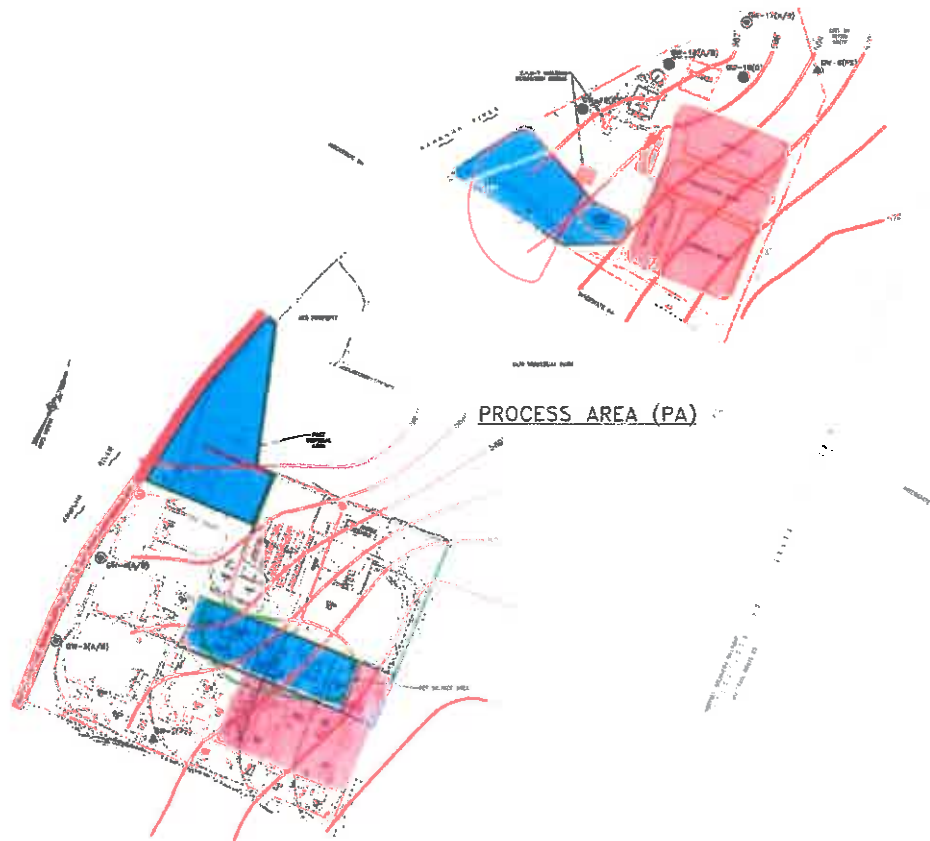
<sup>(2)</sup> "Safe Load Level" for the Site established to the TMDL Report: "Dioxin TMDL Development for Kanawha River, Pocatalico River and Armour Creek, West Virginia", dated September 14, 2000, prepared for U.S EPA Region III by Tetra-Tech, Inc.

<sup>(3)</sup> See Figure XXX "IM Effectiveness Monitoring Wells" for well locations

<sup>(4)</sup> The IM Monitoring point will be in the river along the site bank.

<sup>(5)</sup> Achievement of groundwater cleanup criteria will require reasonable efforts to eliminate or mitigate further releases of contaminants from SWMUs, impoundments and affected soils, and reduction of contaminant levels, as practicable, over time, to support reasonably expected use. These criteria may include the implementation of institutional and/or engineering controls.

# INTERIM MEASURES EFFECTIVENESS MONITORING WELLS WASTEWATER TREATMENT AREA (WTA)



## LEGEND

### IM MONITORING WELLS

- NEW PROPOSED WELL CLUSTER
- EXISTING FOOD MIGRATION WELL CLUSTER
- EXISTING PLANT STABILITY/FOOD MIGRATION DUAL USE WELL CLUSTER
- ▲ EXISTING PLANT STABILITY WELL CLUSTER
- EXISTING MONITORING WELL
- 372 — GROUNDWATER ELEVATION
- LOW PERMEABILITY CAP (WVSCD-1)
- PERMANENT — PERMEABLE COVER
- LOW PERMEABILITY COVER

GRAPHIC SCALE



MAPING AND DESIGN  
2000-2001 BY JAMES J. JONES, JR. FOR EPA PARTNERSHIP DATED 1/1/01  
REVISIONS BY JAMES J. JONES, JR. 1/1/01

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**POTESTIS**

SOLUTIA NITRO SITE  
NITRO, WEST VIRGINIA

MIGRATION TO KANAWHA RIVER  
VIA GROUNDWATER PATHWAY

51

## **6.0 INTERIM MEASURES WORK PLAN SUMMARY / SCHEDULE**

### **6.1 Scope of Work**

Work to be performed pursuant to this IM Work Plan – including the IM-EMP – are summarized as follows:

- i. The following activities will precede installation of the barrier walls (i.e. Item ii):
  - a) A geological investigation along the 3 barrier wall pathways to determine depth to B/R and overburden/bedrock characterization;
  - b) Excavation and clearing of the barrier wall pathway of all physical obstructions/debris;
  - c) Completion of needed agreements among all responsible parties involved with the WVABCA Parcel B incorporation into the PDA IM;
  - d) Final delineation of the extent of cap and barrier wall pathway for incorporation of WVABCA Parcel B into the PDA IM;
  - e) Completion of needed agreements among responsible parties involved with the HUB Industrial Park Drainway project and installation prior to or in conjunction with the PDA IM.
- ii. Installation of three groundwater barrier walls totaling approximately 8000 LF
  - a) PA - PCE Source Area;
  - b) PDA;
  - c) WTA - Old Nitro Dump and Waste Pond.
- iii. Installation of two (2) additional IM Effectiveness Monitoring Well pairs.
- iv. Installation of approximately 122 acres of Site Caps and Covers as detailed in Tables 4-1, "Interim Measures; and Table 4-2, "Interim Measures Technical Specifications."
- v. Riverbank clearing, grading and armoring.
  - a) PA – 2500 LF;
  - b) WTA – Southern 1600 LF.
- vi. Institutional Controls
  - a) Land use restricted to commercial / Industrial through the implementation of restrictive covenants that meet West Virginia requirements<sup>9</sup>;

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<sup>9</sup> An environmental covenant executed pursuant to the Voluntary Remediation and Redevelopment Act, West Virginia Code Chapter 22, Article 22, and the Uniform Environmental Covenants Act, West Virginia Code Chapter 22, Article 22B

- b) Prohibition of groundwater extraction for any purpose other than monitoring through the implementation of restrictive covenants that meet West Virginia requirements.

Detailed design plans for the barrier walls, Caps and Covers will be submitted for review and approval pursuant to the enclosed schedule (See Tab 6.0 Schedule).

## 6.2 Schedule

The RCRA Deliverable Schedule on the following page reflects the following key completion milestones:

o	IM Work Plan approval	04/29/10
o	Barrier wall(s) investigation/clearing	12/2010
o	Barrier wall(s) installations	04/2012
o	Site Cover Installations	01/2015

## 6.3 Reporting

During the multiyear IM construction period (2010 – 2014), progress reports and future plans will be submitted to the Agencies on a quarterly basis by the 20<sup>th</sup> of the month following each quarter. Quarterly reports will be due: January 20, April 20, July 20, and October 20. In addition, it is anticipated that occasional progress meetings, site visits with USEPA and WVDEP will take place as well.

# 04-09-10 RCRA Deliverable Schedule

✓	Flexsys Demolition	412 days	Fri 4/9/04	Mon 11/7/05	
8 ✓	Soils Stabilization Plan - PA / WWTP & Site Handoff	296 days	Wed 10/6/04	Wed 11/23/05	
17 ✓	CA-760 EI	576 days	Mon 4/19/04	Mon 7/3/06	
27 ✓	CA-726 EI	477 days	Mon 10/18/04	Tue 8/15/06	
26 ✓	Expanded - RFI (Groundwater)	540 days	Wed 10/6/04	Tue 10/31/06	
35 ✓	Abandonment of GW wells / TCE Rec system shutdown	39 days	Wed 10/6/04	Mon 11/29/04	
41 ✓	Expanded - RFI (Soils & SWMUs)	507 days	Wed 10/6/04	Thu 9/14/06	
46 ✓	Expanded RFI Report	547.5 days	Wed 11/16/06	Fri 5/8/08	
72 ✓	Corrective Measures Study (CMS)	434 days	Mon 9/1/08	Thu 4/29/10	
73 ✓	Develop & Submit CMS Work Plan	1 mon	Mon 9/1/08	Fri 9/25/08	
74 ✓	Agencies Draft Comments to Solution	39 days	Mon 9/29/08	Thu 11/20/08	73
75 ✓	Solutia Reviews Draft Comments / Schedule Review Meeting	7.8 wks	Mon 9/29/08	Thu 11/20/08	
76 ✓	Meet to discuss Agency Draft Comments	1 day	Wed 7/22/09	Wed 7/22/09	75
77 ✓	Submit revised Work Plan as Interim Measures Work Plan	9.8 mons	Thu 7/23/09	Thu 4/8/10	76
78 ✓	Interim Measures Work Plan- Agencies' Review / Comment / Approval	3 wks	Fri 4/9/10	Thu 4/29/10	77
79					
80	Implement Interim Measures	1240 days	Fri 4/30/10	Thu 1/29/11	78
81					
82	GW Barrier Walls (3) Installation	520 days	Fri 4/30/10	Thu 4/26/12	
83					
84	Pre-design geological investigation	90 days	Fri 4/30/10	Thu 7/8/10	79
85	Submit Work Plan for Approval	1 wk	Fri 4/30/10	Thu 5/6/10	
86	Receive Agencies' Approval	1 wk	Fri 5/7/10	Thu 5/13/10	85
87	Implement investigation / receive results	2 mons	Fri 5/14/10	Thu 7/8/10	86
88					
89	WVABCA Parcel B	180 days	Fri 4/30/10	Thu 9/16/10	
90	Finalize Agreements to include Parcel B Within PDA interim Measure	3 mons	Fri 4/30/10	Thu 7/22/10	77
91	Select Final Barrier Wall Location along Parcel B Eastern Boundary	2 mons	Fri 7/23/10	Thu 9/16/10	90
92					
93	HUB Industrial Park Stormwater Drainway	420 days	Fri 4/30/10	Thu 12/8/11	78
94	Finalize project scope and agreements	6 mons	Fri 4/30/10	Thu 10/14/10	
95	Design / bid / select contractor / move / install Drainway / demobe	15 mons	Fri 10/15/10	Thu 12/8/11	94
96					
97	Barrier Wall Pathway Clearing - RFP / Contractor Selection / implementation	160 days	Fri 4/30/10	Thu 12/8/10	78
98	Project design & approval / RFP development / Contractor selection	3 mons	Fri 4/30/10	Thu 7/22/10	
99 ✓	Barrier Wall Pathway Clearing	5 mons	Fri 7/23/10	Thu 12/9/10	88,87
100					
101	Barrier Walls (3) Installation	360 days	Fri 12/10/10	Thu 4/26/12	99
102	Project Design / RFP Development / Contractor Selection	6 mons	Fri 12/10/10	Thu 5/26/11	
103	Install ~ 7500 LF of Slurry Walls	240 days	Fri 5/27/11	Thu 4/26/12	102
104	Move & install Barrier around TCE Source Area	3 mons	Fri 5/27/11	Thu 8/18/11	
105	Install Barrier Wall around PDA	2 mons	Fri 12/9/11	Thu 2/2/12	104,96
106	Install Barrier Wall around Old Nitro Dump and Waste Pond-demobe	3 mons	Fri 2/3/12	Thu 4/26/12	105
107					
108	Site Covers Design and Installation	720 days	Fri 4/27/12	Thu 1/29/15	
109	PA - Impermeable and Permeable Covers	18 mons	Fri 4/27/12	Thu 9/12/13	107
110	River Bank Armoring	18 mons	Fri 4/27/12	Thu 9/12/13	107
111	WWTP - Impermeable and Impermeable Covers	18 mons	Fri 9/13/13	Thu 1/28/15	110
112					
113	RELATED PROJECTS	1360 days	Tue 1/1/08	Mon 4/15/13	
114					
115	SOLUTIA SITE REDEVELOPMENT	1320 days	Tue 1/15/08	Mon 2/4/13	
116	Development of Redevelopment Master plan	36 mons	Tue 1/15/08	Mon 10/18/10	
117 ✓	Coordinate Solutia Site Interim Measures and Redevelopment	30 mons	Tue 10/18/10	Mon 2/4/13	
118					
119	KANAWHA RIVER SITE ASSESSMENT	1390 days	Tue 1/1/08	Mon 4/15/13	
120 ✓	Coordinate River Segment project with Solutia Site interim Measures	40 mons	Tue 1/1/08	Mon 4/15/13	

## **7.0 CLOSING**

This report has been prepared to assist Solutia in evaluating the current environmental conditions at the Site. POTESta and Solutia mutually devised the scope of this study, and is limited to the specific project, location, and time-period described herein. The report represents POTESta's understanding of the Site conditions as discernible from information provided by others and obtained by POTESta using the methods specified. POTESta assumes no responsibility for information provided or developed by others or for documenting conditions detectable with methods or techniques not specified in the scope of services. In addition, no activity, including sampling, assessment or evaluation of material or substance, may be assumed to be included in this study unless specifically considered in the scope of services and this report. Sketches and maps in this report are included only to aid the reader and should not be considered surveys or engineering studies. If additional data concerning this Site become available, POTESta should be informed so that we may examine the information and, if necessary, modify this report accordingly.

# ***APPENDIX A***

## Pre-Interim Measures TCDD Flux to River

Pre-Interim Measures - TCDD Flux (average soluble) to Kanawha River via the Groundwater Pathway in 2008				
Basis - 2008 Supplemental Data Collection- Two rounds of high volume Dioxin sampling during 2Q08 and 3Q08				
Groundwater Zone / Site Area	GW Flow	AVG TCDD Conc	AVG TCDD Flux	COMMENTS
	gpd	pg/l	ug/day	
A-Shallow Zone Flux	PA Flux	36	0.055	0.00001
	PDA Flux(avg)	206	0.138	0.00011
	WTA	328	0.552	0.00068
B-Deep Zone Flux	PA Flux	7017	0.003	0.00009
	PDA Flux	2447	0.035	0.00033
	WTA	9049	0.178	0.00611
Total	18,083	0.101	0.00732	
			16.5	TMDL TCDD allocated load (ug/day) to contaminated GW @ 7Q10 Flow- June'98 TMDL, Pg 42
			0.04%	AVG TCDD flux as % of allocated TCDD load

Conversions  
3.785412

Basis - 2008 Supplemental Data Collection- Two rounds of high volume Dioxin sampling during 2Q08 and 3Q08							
Wells		A Aquifer TCDD Conc (pg/L)			B Aquifer TCDD Conc (pg/L)		
		2Q08	3Q08	Average	2Q08	3Q08	Average
PA	GW-3 GW-4	0.0004 0.16	0.0033 0.16	0.055	0.0023 0.007	0.0027 0.001	0.003
PDA	GW-9 GW-10 GW-11	0.11 0.22 0.031	0.14 0.26 0.065	0.138	0.085 0.009 0.016	0.079 0.021 0.0009	0.035
WTA	GW-12 GW-13 GW-14 GW-15 GW-16 GW-17	0.0265 0.0043 4.7 0.26 0.052 0.0006	0.68 0.0045 4.7 0.27 0.078 0.0004	0.552	0.82 0.75 0.315 0.008 0.0008 0.007	0.053 0.0225 0.345 0.014 0.0015 0.0031	0.178

Non-detect - TCDD Conc. = DL/2

## Post Interim Measures TCDD Flux to the River

Post Interim Measures - TCDD Flux (average soluble) to Kanawha River via the Groundwater Pathway in 2008				
Basis - 2008 Supplemental Data Collection- Two rounds of high volume Dioxin sampling during 2Q08 and 3Q08				
Groundwater Zone / Site Area	GW Flow	Avg TCDD Conc	Avg TCDD Flux	COMMENTS
	gpd	pg/l	ug/day	
A-Shallow Zone Flux	PA Flux	36	0.055	0.00001
	PDA Flux(avg)	206		
	WTA	328	0.110	0.00014
B-Deep Zone Flux	PA Flux	7017	0.008	0.00009
	PDA Flux	2447		
	WTA	9049	0.008	0.00020
Total	19,083	0.006	0.00043	TCDD Flux to river in groundwater
			94%	Reduction in TCDD Flux vs. 0.0076 pg/day avg TCDD flux before IMs
			42%	Avg TCDD Conc in GW as percentage of TMDL limit for Kanawha River (0.014 pg/L)
			16.5	TCDD allocated load to GW @ 7Q10 Flow - June '98 TMDL Report, Pg 42
			0.003%	TCDD flux as % of allocated TCDD load

### Conversions

3.7854118

Average TCDD concentration in GW Post Interim Measures (i.e. without PDA + Old Nitro Dump)							
Wells		A-Aquifer TCDD Conc (pg/L)			B-Aquifer TCDD Conc (pg/L)		
		2Q08	3Q08	Average	2Q08	3Q08	Average
PA	GW-3 GW-4	0.0004	0.0013 0.16	0.055	0.0013 0.007	0.0027 0.001	0.003
PDA	GW-9 GW-10 GW-11	Eliminated with containment of PDA					
WTA	GW-12 GW-13 GW-14	Eliminated with containment of Old Nitro Dump					
	GW-19 GW-18	0.26 0.052	0.27 0.078	0.110	0.008 0.0008	0.014 0.0015	0.006
	GW-17	0.0006	0.0004		0.007	0.0031	



## Appl 2

## 2Q08 Dioxin Results Round 1

[illegible]

### Detection

**IEF - Toxicity Equivalency Factor**

**TEQ** - Based on EPA TEF system with the value for non-detects equal to DL/2

A - Upper Aquifer  
B - Lower Aquifer

Insoluble - Concentration from extractions from 1-litre liter

**Soluble** - Concentration of extractant from (A) resin

### 3Q08 Dioxin Results Round 2

### Detection

**TEQ** - Based on EPA TEQ system with the value for non-detects equal to DL/2

A - Upper Aquifer  
B - Lower Aquifer

#### **Immunoblot**—Analysis of extractant from 1- $\mu$ m filter

**Solubility** - Analyses of extractants from XAD resin

# 2008 Supplemental Data Collection

## 3Q08 Dioxin Results Round 2

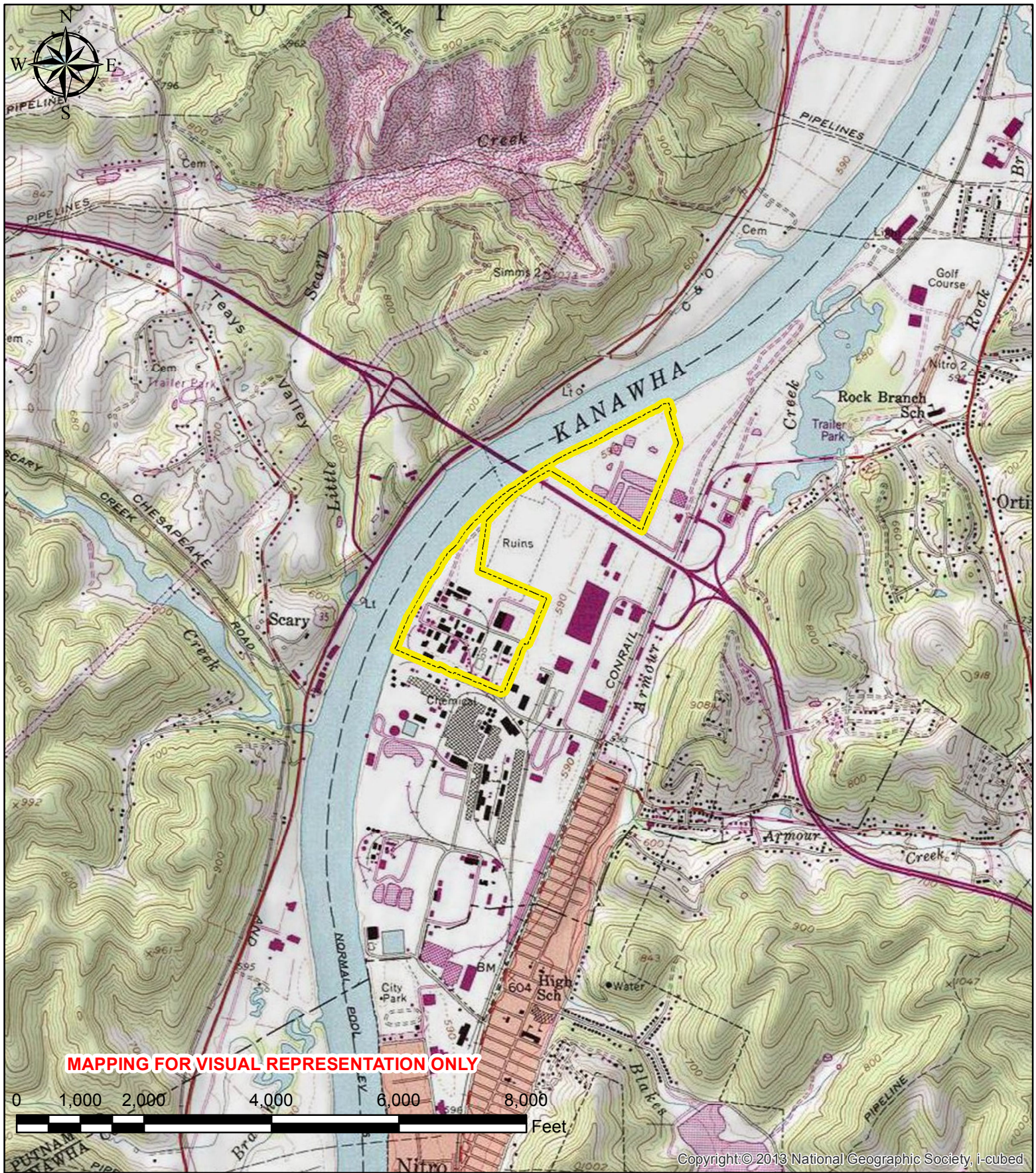
Weeks		2004-2005		2005-2006		2006-2007		2007-2008		2008-2009		2009-2010		2010-2011		2011-2012		2012-2013		2013-2014		2014-2015		2015-2016		2016-2017		2017-2018		2018-2019		2019-2020		2020-2021		2021-2022		2022-2023		2023-2024		2024-2025		2025-2026		2026-2027		2027-2028		2028-2029		2029-2030		2030-2031		2031-2032		2032-2033		2033-2034		2034-2035		2035-2036		2036-2037		2037-2038		2038-2039		2039-2040		2040-2041		2041-2042		2042-2043		2043-2044		2044-2045		2045-2046		2046-2047		2047-2048		2048-2049		2049-2050		2050-2051		2051-2052		2052-2053		2053-2054		2054-2055		2055-2056		2056-2057		2057-2058		2058-2059		2059-2060		2060-2061		2061-2062		2062-2063		2063-2064		2064-2065		2065-2066		2066-2067		2067-2068		2068-2069		2069-2070		2070-2071		2071-2072		2072-2073		2073-2074		2074-2075		2075-2076		2076-2077		2077-2078		2078-2079		2079-2080		2080-2081		2081-2082		2082-2083		2083-2084		2084-2085		2085-2086		2086-2087		2087-2088		2088-2089		2089-2090		2090-2091		2091-2092		2092-2093		2093-2094		2094-2095		2095-2096		2096-2097		2097-2098		2098-2099		2099-2100		2100-2101		2101-2102		2102-2103		2103-2104		2104-2105		2105-2106		2106-2107		2107-2108		2108-2109		2109-2110		2110-2111		2111-2112		2112-2113		2113-2114		2114-2115		2115-2116		2116-2117		2117-2118		2118-2119		2119-2120		2120-2121		2121-2122		2122-2123		2123-2124		2124-2125		2125-2126		2126-2127		2127-2128		2128-2129		2129-2130		2130-2131		2131-2132		2132-2133		2133-2134		2134-2135		2135-2136		2136-2137		2137-2138		2138-2139		2139-2140		2140-2141		2141-2142		2142-2143		2143-2144		2144-2145		2145-2146		2146-2147		2147-2148		2148-2149		2149-2150		2150-2151		2151-2152		2152-2153		2153-2154		2154-2155		2155-2156		2156-2157		2157-2158		2158-2159		2159-2160		2160-2161		2161-2162		2162-2163		2163-2164		2164-2165		2165-2166		2166-2167		2167-2168		2168-2169		2169-2170		2170-2171		2171-2172		2172-2173		2173-2174		2174-2175		2175-2176		2176-2177		2177-2178		2178-2179		2179-2180		2180-2181		2181-2182		2182-2183		2183-2184		2184-2185		2185-2186		2186-2187		2187-2188		2188-2189		2189-2190		2190-2191		2191-2192		2192-2193		2193-2194		2194-2195		2195-2196		2196-2197		2197-2198		2198-2199		2199-2200		2200-2201		2201-2202		2202-2203		2203-2204		2204-2205		2205-2206		2206-2207		2207-2208		2208-2209		2209-2210		2210-2211		2211-2212		2212-2213		2213-2214		2214-2215		2215-2216		2216-2217		2217-2218		2218-2219		2219-2220		2220-2221		2221-2222		2222-2223		2223-2224		2224-2225		2225-2226		2226-2227		2227-2228		2228-2229		2229-2230		2230-2231		2231-2232		2232-2233		2233-2234		2234-2235		2235-2236		2236-2237		2237-2238		2238-2239		2239-2240		2240-2241		2241-2242		2242-2243		2243-2244		2244-2245		2245-2246		2246-2247		2247-2248		2248-2249		2249-2250		2250-2251		2251-2252		2252-2253		2253-2254		2254-2255		2255-2256		2256-2257		2257-2258		2258-2259		2259-2260		2260-2261		2261-2262		2262-2263		2263-2264		2264-2265		2265-2266		2266-2267		2267-2268		2268-2269		2269-2270		2270-2271		2271-2272		2272-2273		2273-2274		2274-2275		2275-2276		2276-2277		2277-2278		2278-2279		2279-2280		2280-2281		2281-2282		2282-2283		2283-2284		2284-2285		2285-2286		2286-2287		2287-2288		2288-2289		2289-2290		2290-2291		2291-2292		2292-2293		2293-2294		2294-2295		2295-2296		2296-2297		2297-2298		2298-2299		2299-2300		2300-2301		2301-2302		2302-2303		2303-2304		2304-2305		2305-2306		2306-2307		2307-2308		2308-2309		2309-2310		2310-2311		2311-2312		2312-2313		2313-2314		2314-2315		2315-2316		2316-2317		2317-2318		2318-2319		2319-2320		2320-2321		2321-2322		2322-2323		2323-2324		2324-2325		2325-2326		2326-2327		2327-2328		2328-2329		2329-2330		2330-2331		2331-2332		2332-2333		2333-2334		2334-2335		2335-2336		2336-2337		2337-2338		2338-2339		2339-2340		2340-2341		2341-2342		2342-2343		2343-2344		2344-2345		2345-2346		2346-2347		2347-2348		2348-2349		2349-2350		2350-2351		2351-2352		2352-2353		2353-2354		2354-2355		2355-2356		2356-2357		2357-2358		2358-2359		2359-2360		2360-2361		2361-2362		2362-2363		2363-2364		2364-2365		2365-2366		2366-2367		2367-2368		2368-2369		2369-2370		2370-2371		2371-2372		2372-2373		2373-2374		2374-2375		2375-2376		2376-2377		2377-2378		2378-2379		2379-2380		2380-2381		2381-2382		2382-2383		2383-2384		2384-2385		2385-2386		2386-2387		2387-2388		2388-2389		2389-2390		2390-2391		2391-2392		2392-2393		2393-2394		2394-2395		2395-2396		2396-2397		2397-2398		2398-2399		2399-2400		2400-2401		2401-2402		2402-2403		2403-2404		2404-2405		2405-2406		2406-2407		2407-2408		2408-2409		2409-2410		2410-2411		2411-2412		2412-2413		2413-2414		2414-2415		2415-2416		2416-2417		2417-2418		2418-2419		2419-2420		2420-2421		2421-2422		2422-2423		2423-2424		2424-2425		2425-2426		2426-2427		2427-2428		2428-2429		2429-2430		2430-2431		2431-2432		2432-2433		2433-2434		2434-2435		2435-2436		2436-2437		2437-2438		2438-2439		2439-2440		2440-2441		2441-2442		2442-2443		2443-2444		2444-2445		2445-2446		2446-2447		2447-2448		2448-2449		2449-2450		2450-2451		2451-2452		2452-2453		2453-2454		2454-2455		2455-2456		2456-2457		2457-2458	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# *APPENDIX E*


## Interim Measures Technical Specifications

IM Type	Applicable Site Area(s)	Specifications
Low Permeability Cap		
	PDA PA TCE Source Area Old Nitro Dump / Waste Pond	Compliant with WV 33CSR1 (Subtitle C)
		° 18" (avg.) bedding layer
		° Geotextile Cushion
		° 40 mil HDPE
		° Composite Drainage Layer
		° Piping over Drainage Layer
		° 18" Vegetative Soil Layer
Low Permeability Cover		
	PA Former 2,4,5-T Manuf. Area	° 8" soil bedding layer
	WTA Impoundments	° 40 mil HDPE
	- Emergency Basin	° Geotextile
	- Surge Basin	° 18" Vegetative Soil Layer
	- Equalization Basin	
	- A3 Basin	
	- Limestone Bed	
WTA - 2,4,5-T building demolition debris disposal area		
Permanent, Permeable Cover		
	All areas of the Site without Low Permeability Caps or Low Permeability Covers	° Geotextile
		° 18" Vegetative Soil Layer
Barrier Wall		
	PDA PA TCE Source Area Old Nitro Dump / Waste Pond	Soil / bentonite (~2 %) Slurry Wall
		1x10 <sup>-7</sup> cm/sec permeability
		Width ~ 2-3 ft.
		Depth - ~ 55-60 ft. to impervious strata
		Keyed ~ 3 ft into underlying impervious strata
River Bank Armoring w/ Rock Riprap		
	PA Riverbank (~ 2500 LF) Southern WTA Riverbank (~ 1600 LF)	Commercially Purchased Limestone
		Hard, durable limestone w/ d50 of 12"
		Rock size range of 6" min. to ≤ 18" max. with ≤ 6% by weight < 6"
		≤ 30% weight loss when subjected to 5 cycles of Sodium Sulfate Soundness Test - ASTM C88-99a Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate as modified by the American Association of State Transportation Officials (AASHTO) T-104

# ***APPENDIX F***



## Legend

 Solutia Property



ENGINEERS AND ENVIRONMENTAL CONSULTANTS

DATE: FEBRUARY 2016

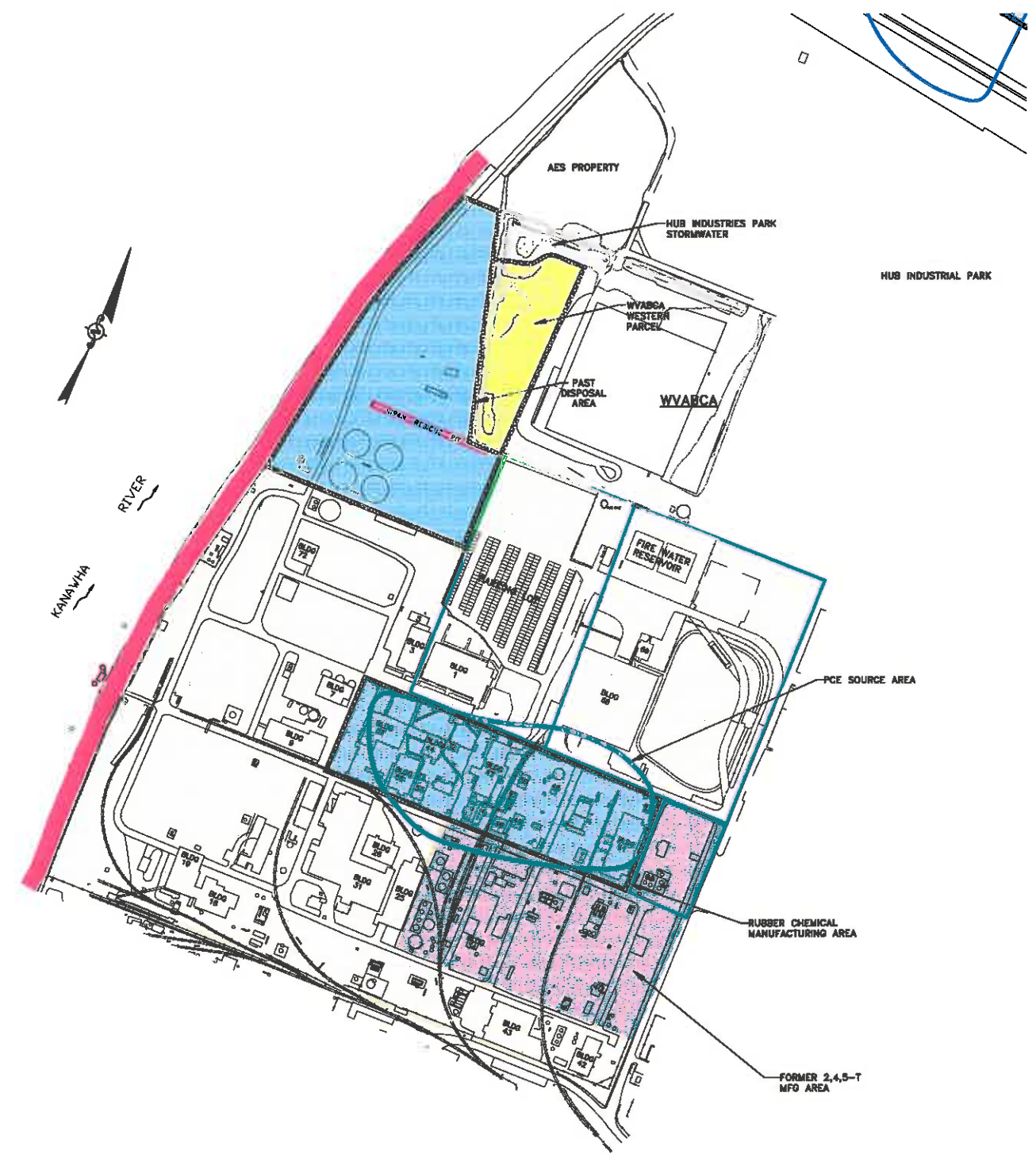
PROJECT NO.: 0101-01-0081

SCALE: SEE SCALE BAR

**SITE LOCATION MAP  
SOLUTIA INC. NITRO SITE  
NITRO, PUTNAM CO., WV**

G:\Projects\200101-0081 Solutia (new)\Map Documents\02-17-2016\_  
SiteLocationMap.mxd

PA – PROPOSED INTERIM MEASURES



LEGEND

CAPS & COVERS

- LOW PERMEABILITY CAP (WV33CSR-1)
- PERMANENT - PERMEABLE COVER
- LOW PERMEABILITY COVER
- RIVERBANK ARMORING

GROUNDWATER

- GROUNDWATER CONTAINMENT

CONTIGUOUS PROPERTY

- WYARCA WESTERN PARCEL



MAPPING REFERENCE:  
BASE MAPPING PREPARED BY PHOTO SCIENCE, INC. FROM AERIAL PHOTOGRAPHY DATED 2/17/06.  
SUBSEQUENT REVISIONS COMPLETED BY FLEXSYS AMERICA L.P.

2008 FIG 4.1  
CAD File No.  
BFL  
Drawn  
DML  
Checked  
DML  
Approved  
NOT TO SCALE  
Scale:  
OCTOBER 2009  
Date:  
01-0081-700A  
Project No.

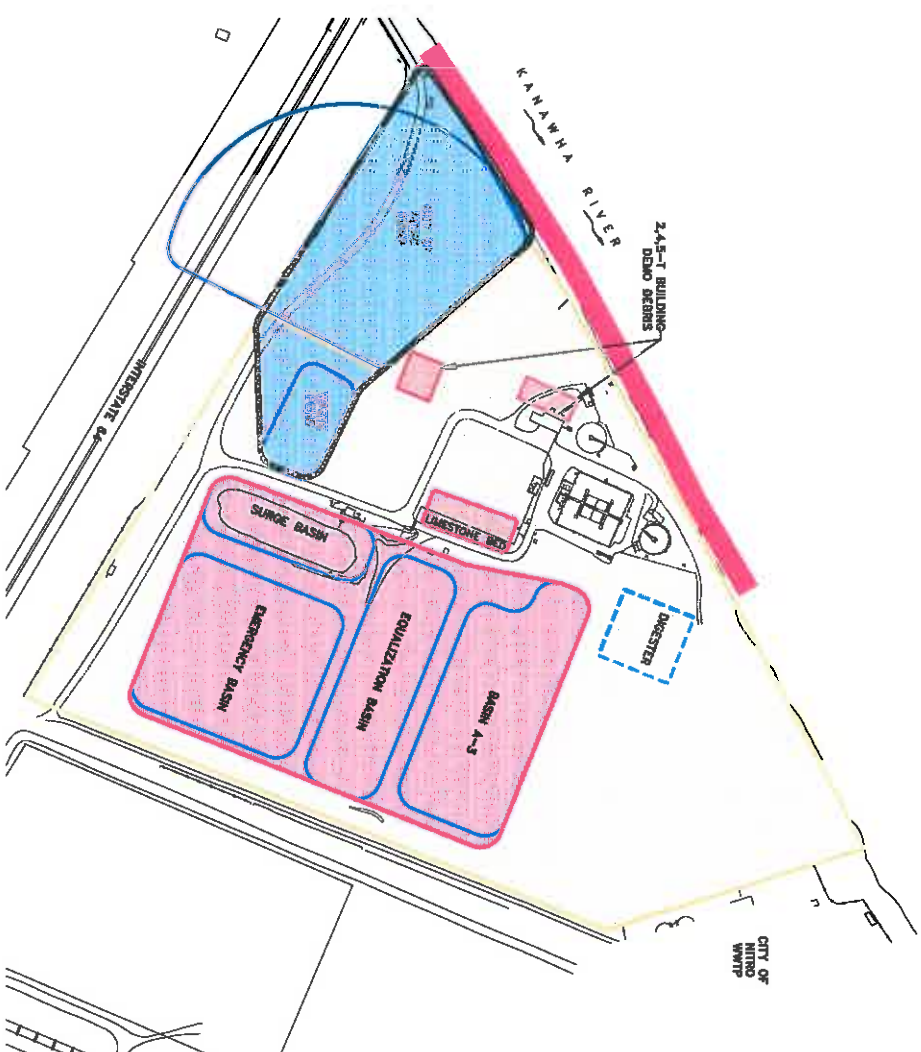
**POTESTA**  
Potesta & Associates, Inc.  
Environmental Remediation  
1915 MacArthur Blvd., Suite 200  
Falls Church, VA 22041  
TEL: (800) 845-1400 FAX: (800) 845-8011  
E-Mail: [info@potesta.com](mailto:info@potesta.com)

SOLUTIA NITRO SITE  
NITRO, WEST VIRGINIA

PROCESS AREA  
INTERIM MEASURES

4.1  
Figure No.

## WTA -- PROPOSED INTERIM MEASURES



## LEGEND

## CAPS & COVERS

- The diagram illustrates the layers of groundwater containment. From top to bottom, the layers are: a blue square representing the 'LOW PERMEABILITY CAP (WVCGRS-1)', a yellow square representing 'PERMANENT - PERMEABLE COVER', a red square representing 'LOW PERMEABILITY COVER', and a pink square representing 'RIVERBANK ARMORING'. Below these layers is a black hatched area labeled 'GROUNDWATER CONTAINMENT'.

MAPING EVIDENCE:  
BASE MAPING PREPARED BY PHOTO SCIENCE, INC FROM AERIAL PHOTOGRAPHY DATED 2/17/85.  
SUBSEQUENT REVISIONS COMPLETED BY FLEISCHER AMERICA L.P.

# ***APPENDIX G***

# **FINAL CAPS AND COVERS MAINTENANCE AND MONITORING PLAN**

## ***Solutia Inc. Nitro Site Nitro, West Virginia***

*Prepared for:*

**Solutia Inc.**  
575 Maryville Centre Drive  
St. Louis, Missouri 63166

*Prepared by:*

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Project No. 0101-01-0081-700C

May 15, 2015

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**POTESTA**

## TABLE OF CONTENTS

INTRODUCTION .....	1
I. RIVERBANK ARMORING .....	1
II. STORM WATER MANAGEMENT SYSTEM .....	2
III. FINAL CAPS AND COVERS .....	3
IV. FENCING AND GATES.....	3
V. GROUNDWATER PUMPING AND TREATMENT SYSTEM.....	3
VI. MISCELLANEOUS ITEMS .....	4
VII. MONITORING CHECKLIST AND REPORTING.....	5

### **APPENDICES**

Monitoring Checklist .....	APPENDIX A
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# **FINAL CAPS AND COVERS MAINTENANCE AND MONITORING PLAN**

## **INTRODUCTION**

Solutia, Inc. (Solutia) is implementing interim measures at their Nitro, West Virginia property (Site) under a Resource Conservation and Recovery Act (RCRA) Corrective Action Permit, ID WV039990965. Interim measures include installation of four soil-bentonite barrier walls, creating groundwater containment areas. Nine groundwater pumping wells will be used to remove groundwater from the containment areas, thus maintaining an inward gradient at each containment area. Groundwater from the nine wells will be pretreated (aerated followed by filtration) to remove iron, then pumped and treated by liquid phase granular activated carbon prior to being discharged through one of three permitted National Pollutant Discharge Elimination System (NPDES) outlets serving the Site. Interim measures also include placing riprap armoring on a portion of the Kanawha River bank and construction of approximately 115 acres of final caps and covers. Interim measures were designed to minimize the potential for human exposures to TCDD (Dioxin)-affected soils as well as the potential for migration of site-related constituents of concern to the Kanawha River via groundwater or surface runoff.

Soil-bentonite containment walls and extraction wells were constructed during 2011. Riverbank armoring was completed during 2012 and 2013. Installation of final caps and covers, including a storm water management system and groundwater pumping equipment and piping, began in 2012 and will be completed during 2015.

This maintenance and monitoring plan was developed as a guide for future observations of the interim measures components to ensure that these components remain in place and are capable of functioning as intended. Monitoring of interim measures components will be completed semi-annually during 2015 and 2016, and annually thereafter. This plan identifies the components to be included in the maintenance and monitoring program, the observations to be included in the maintenance and monitoring program, and a checklist to facilitate monitoring and documentation of the results. It is envisioned that monitoring will be used to identify maintenance needed for the continued performance of the interim measures.

## **I. RIVERBANK ARMORING**

The interim measures final caps and covers installation project included grading and a geotextile and limestone riprap blanket placed over approximately 2,400 linear feet of the right descending bank of the Kanawha River within the former process area. Riprap was placed from just below the normal pool elevation (566.0 feet above mean sea level) to the top of bank. Slopes for the riprap blanket ranged from 2.5 horizontal to 1 vertical to 2 horizontal to 1 vertical.

Monitoring will include visual observations to verify the following:

1. Riprap blanket is intact over the riverbank armoring area. Riprap is in place from just below the normal pool water line to the top of riverbank, and over the 2,400 foot length.
2. Signs of erosion or movement of riprap blanket will be noted. Erosion or movement of riprap which threatens the stability and/or performance of riprap armoring will require remedial measures.
3. Observe concrete headwalls, riprap, and grouted riprap below Outlet 001 and the HUB drainage culvert. Riprap and grouted riprap should be in place and appear stable so that water discharges are conveyed from the culverts/pipes to the river. Check the duckbill valve at the HUB drain to verify that the valve is free from debris and that the valve is attached to the culvert and intact.
4. Verify that trees and shrubs which may volunteer in the riverbank armoring area are not causing damage or displacement to the rock riprap. Removal of volunteer vegetation is not necessary unless vegetation is resulting in damage of the riprap armoring.

## **II. STORM WATER MANAGEMENT SYSTEM**

The final caps and covers included a system of drop inlets and culverts within the process area to collect surface runoff and convey it to the National Pollutant Discharge Elimination System (NPDES) Outlet 001 outfall. Storm water culverts between drop inlets were slip-lined with fusion welded high density polyethylene (HDPE) pipe due to problems with infiltration of groundwater through gasketed joints in the original push joint culverts. Slip-lining addressed groundwater infiltration as piping is continuous between drop inlets. The storm water management system also includes drainage swales and channels at the West Virginia Alcoholic Beverage Control Administration (ABCA) western parcel and waste treatment area (WTA). The drainage swale at the ABCA western parcel conveys surface water runoff to the HUB Industrial Park (HUB) drainage swale and culvert and the drainage swales and channels at WTA convey much of the surface runoff to Outlets 002 and 003.

Monitoring will include visual observations to verify the following:

1. Drop inlets are functioning and are able to receive storm water runoff and convey it to the storm water piping system. Grates covering drop inlets are in place and free of obstructions.
2. Drop inlets are free from excessive accumulations of sediment or debris that could obstruct flow.
3. Cap system underdrain outlets which discharge in the drop inlet boxes are unobstructed and are able to freely discharge.
4. Drainage swales at ABCA are intact with no restrictions of flow and are vegetated or otherwise stable. Verify that swales are not experiencing excessive erosion along the bottoms or side slopes.

5. Drainage swales and channels at WTA are intact with no restrictions of flow. Verify that drainage swales and channels are vegetated and stable and that drainage swales and channels are not experiencing excessive erosion along the bottoms or side slopes.
6. NPDES Outlets 001, 002 and 003 are stable and unobstructed. Signage marking each outlet is in place and visible.
7. Culverts/pipes carrying surface runoff under gravel access roads are functioning and in place, and that pipe ends/openings are unobstructed.

### **III. FINAL CAPS AND COVERS**

Final caps and covers include three different types. The low permeability cap is the most robust and includes from the bottom to the top a nonwoven geotextile, 40 mil linear low density polyethylene geomembrane, a drainage composite (nonwoven geotextile heat bonded over a high density polyethylene drainage net), and 18 inches of clean soil cover. The low permeability cap was installed over the soil-bentonite barrier wall containment areas. The low permeability cover is the second type of cap/cover. The low permeability cover includes the following layers from the bottom to the top: 40 mil linear low density polyethylene geomembrane, nonwoven geotextile, and 18 inches of clean soil cover. The low permeability cover was installed over a portion of the process area and the WTA. The final cover type installed is the permanent permeable cover. This cover was installed over parts of the process area and WTA. The permanent permeable cover includes a nonwoven geotextile covered with 18 inches of clean soil.

The only component of the final caps and covers visible is the surface of the clean soil cover layer. Monitoring will include visual observations to verify the following:

1. Surface of the soil cover layer is stable with no excessive erosion.
2. Surface of the soil covers is free from sloughs and landslides.
3. Vegetation of the soil covers is suitable. Bare areas should be noted and identified for reseeding.
4. Vegetation should be mowed at a frequency suitable to prevent trees and shrubs from establishing on the soil cover.

### **IV. FENCING AND GATES**

The majority of the Nitro property is bounded by a chain link fence. Gates are present at the main entrance in the process area and at the WTA. Monitoring to include confirmation that all fencing and gates are intact and functional.

### **V. GROUNDWATER PUMPING AND TREATMENT SYSTEM**

A groundwater pumping and treatment system at the site includes nine pumping wells and underground piping to convey groundwater from each pumping well to one of three

lift stations. At each lift station (one each in the process area, past disposal area, and WTA soil-bentonite containment wall areas), groundwater is batch processed in a pre-treatment unit to remove iron before being pumped by the lift station to a liquid phase granular activated carbon (LGAC) treatment unit near the main site entrance in the process area. After passing through the LGAC unit, treated groundwater is piped to a drop inlet that is part of the storm water management system.

Operation and maintenance of the groundwater pumping and treatment system is covered by a separate plan. The groundwater pumping and treatment system also included provisions to allow its operation to be monitored remotely. Monitoring of the groundwater pumping and treatment system under this plan will be limited to the following:

1. Observe pumping well vaults to verify that lids are closed and locked. Open each lid to make certain that piping/tubing is secure at each well head and that piping/tubing is not leaking.
2. Verify that each pump is functioning.
3. Verify that each pretreatment unit is functioning. Observe visible piping connections to make sure pipes and connections are watertight.
4. Verify that pump stations are functioning by manually starting and stopping each submersible pump. Observe each valve vault at each lift station while pumps are on. Make sure piping/valve connections are watertight and not leaking. Return pump controls to automatic setting after observations are made.
5. Verify that piping connections at the LGAC treatment unit are intact without leaks.
6. Verify that overhead electric service poles, conductor wires and guy wires are intact with no problems.

## **VI. MISCELLANEOUS ITEMS**

Miscellaneous features associated with the final caps and covers include stone-covered access roads, piezometers (gradient monitoring wells) used to monitor the groundwater gradient across the soil-bentonite slurry wall containment areas, and groundwater monitoring wells.

Monitoring wells and gradient monitoring wells are addressed as part of the ongoing groundwater monitoring program.

Access roads will be reviewed for suitability to allow all weather access. Maintenance required to keep roads in service will be identified.

## **VII. MONITORING CHECKLIST AND REPORTING**

A checklist for use during monitoring visits is included in Appendix A of this plan. The checklist will be completed as part of each monitoring site visit. Problem areas requiring correction or maintenance should be noted on the form and arrangements made to have the necessary maintenance activity completed. Completed inspection forms, as well as a summary of maintenance activities completed, will be included in the Annual Interim Measures – Effectiveness Monitoring Plan Report to be submitted to the regulatory agencies by February 20<sup>th</sup> of each year for the prior year's reporting period.

## ***APPENDIX A***

**MAINTENANCE AND MONITORING CHECKLIST  
FINAL CAPS AND COVERS  
INTERIM MEASURES EFFECTIVENESS MONITORING PLAN  
SOLUTIA INC. – NITRO, WEST VIRGINIA SITE  
RCRA CORRECTIVE ACTION PERMIT I.D. WV039990965**

Date of Monitoring Visit: \_\_\_\_\_  
 Person and Affiliation Completing Monitoring Visit: \_\_\_\_\_ of \_\_\_\_\_  
 General Site Conditions: Weather: \_\_\_\_\_  
 Temperature: \_\_\_\_\_  
 Weather Previous 48 Hours: \_\_\_\_\_

**I. RIVERBANK ARMORING**

- A. Riprap Stone Intact Over Area: ☐ Yes ☐ No  
 (2400 lineal feet, from just below normal pool elevation to top of bank)
- B. Are there signs of erosion or movement of riprap: ☐ Yes ☐ No
- C. Concrete headwalls (Outlet 001 and HUB Drain) Stable: ☐ Yes ☐ No
- D. Grouted riprap below headwalls stable: ☐ Yes ☐ No
- E. Duckbill valve at HUB Drain in place, functioning,  
and free of debris: ☐ Yes ☐ No
- F. Vegetation causing damage to, or displacement of, rock riprap: ☐ Yes ☐ No
- G. List any problem areas or concerns on riverbank, including description of  
 problem, location, size, etc.: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ (use attachment if necessary)

**II. STORM WATER MANAGEMENT SYSTEM**

- A. Drop inlets functioning, grates free of obstructions/debris: ☐ Yes ☐ No
- B. Drop inlets free of excessive accumulations of sediment or debris: ☐ Yes ☐ No
- C. Cap system underdrain outlets unobstructed and able to drain: ☐ Yes ☐ No
- D. WVABCA drainage swales are functioning, vegetated, and  
without excessive erosion: ☐ Yes ☐ No
- E. WTA drainage swales and channels are functioning, vegetated,  
and without excessive erosion: ☐ Yes ☐ No
- F. Outlets 001, 002, and 003 stable and without obstructions with  
signage in place: ☐ Yes ☐ No
- G. Culverts/pipes functioning and unobstructed: ☐ Yes ☐ No

- H. List any problem area or concerns with storm water management system, including a description of problem, location, size, etc.: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
(use attachment if necessary)

### III. FINAL CAPS AND COVERS

- A. Surface of soil cover layer is stable with no excessive erosion: ☐ Yes ☐ No  
B. Surface of soil cover is free of sloughs or soil movement: ☐ Yes ☐ No  
C. Vegetation is suitable: ☐ Yes ☐ No  
D. Presence of trees/brush on caps/covers areas: ☐ Yes ☐ No  
E. List any problem area or concerns with final caps and covers, including a description of problem, location, size, etc.: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
(use attachment if necessary)

### IV: FENCING GATES

- A. Fencing/gates intact and functional: ☐ Yes ☐ No  
B. List any problem area with fencing and gates, including description of problem, location, size, etc.: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
(use attachment if necessary)

### V. GROUNDWATER PUMPING AND TREATMENT SYSTEM

- A. Pumping well vaults and piping is secure without leaks: ☐ Yes ☐ No  
B. Pumps are functioning: ☐ Yes ☐ No  
C. Each iron pretreatment plant is functioning: ☐ Yes ☐ No  
D. Each pump station is functioning: ☐ Yes ☐ No  
E. LGAC unit is functioning: ☐ Yes ☐ No  
F. Overhead electric service is functioning with no issues: ☐ Yes ☐ No  
G. List any problem areas or concerns with groundwater pumping and treatment system: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
(use attachment if necessary)

**VI. MISCELLANEOUS ITEMS**

- A. Monitoring wells secure: ☐ Yes ☐ No  
B. Access roads functional: ☐ Yes ☐ No  
C. List any problem areas, including description of problem, location, details, etc.:

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(use attachment if necessary)